

A Technical Summary of  
Digital's Workstations  
With Application Listing

digital



station





# A Technical Summary of Digital's Workstations With Application Listing

Order Number: EB-32975-51

Model	Processor	Memory
286	286	1 MB
386	386	1 MB
486	486	1 MB
586	586	1 MB
686	686	1 MB
786	786	1 MB
886	886	1 MB
986	986	1 MB
1086	1086	1 MB
1186	1186	1 MB
1286	1286	1 MB
1386	1386	1 MB
1486	1486	1 MB
1586	1586	1 MB
1686	1686	1 MB
1786	1786	1 MB
1886	1886	1 MB
1986	1986	1 MB
2086	2086	1 MB
2186	2186	1 MB
2286	2286	1 MB
2386	2386	1 MB
2486	2486	1 MB
2586	2586	1 MB
2686	2686	1 MB
2786	2786	1 MB
2886	2886	1 MB
2986	2986	1 MB
3086	3086	1 MB
3186	3186	1 MB
3286	3286	1 MB
3386	3386	1 MB
3486	3486	1 MB
3586	3586	1 MB
3686	3686	1 MB
3786	3786	1 MB
3886	3886	1 MB
3986	3986	1 MB
4086	4086	1 MB
4186	4186	1 MB
4286	4286	1 MB
4386	4386	1 MB
4486	4486	1 MB
4586	4586	1 MB
4686	4686	1 MB
4786	4786	1 MB
4886	4886	1 MB
4986	4986	1 MB
5086	5086	1 MB
5186	5186	1 MB
5286	5286	1 MB
5386	5386	1 MB
5486	5486	1 MB
5586	5586	1 MB
5686	5686	1 MB
5786	5786	1 MB
5886	5886	1 MB
5986	5986	1 MB
6086	6086	1 MB
6186	6186	1 MB
6286	6286	1 MB
6386	6386	1 MB
6486	6486	1 MB
6586	6586	1 MB
6686	6686	1 MB
6786	6786	1 MB
6886	6886	1 MB
6986	6986	1 MB
7086	7086	1 MB
7186	7186	1 MB
7286	7286	1 MB
7386	7386	1 MB
7486	7486	1 MB
7586	7586	1 MB
7686	7686	1 MB
7786	7786	1 MB
7886	7886	1 MB
7986	7986	1 MB
8086	8086	1 MB
8186	8186	1 MB
8286	8286	1 MB
8386	8386	1 MB
8486	8486	1 MB
8586	8586	1 MB
8686	8686	1 MB
8786	8786	1 MB
8886	8886	1 MB
8986	8986	1 MB
9086	9086	1 MB
9186	9186	1 MB
9286	9286	1 MB
9386	9386	1 MB
9486	9486	1 MB
9586	9586	1 MB
9686	9686	1 MB
9786	9786	1 MB
9886	9886	1 MB
9986	9986	1 MB



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## Preface

Fewer industries have enjoyed more rapid growth—or have seen more dramatic changes during their evolution—than the high technology industries. A succession of engineering milestones has produced computers and computing solutions that are better designed, more functional, more compact, and more affordable than ever.

Nowhere is this trend more evident than in today's workstations. Significant breakthroughs in packaging, price, and power have made workstations some of the most popular and competitive products in the computer marketplace.

For those who are starting to investigate the many workstation choices available today, this technical summary can help. It discusses workstation concepts and designs, including a general overview of workstation features and functions. Next, it introduces the family of workstation solutions from Digital. Readers who are looking for specific details on Digital's workstations can begin with Chapter 2.

This summary is not a tutorial. Reference books and trade articles describe microprocessor technologies, graphics, and windowing systems in detail. This summary describes the following:

- Chapter 1 introduces Digital's desktop computing environment. Many companies offer desktop solutions. Digital offers an integrated computing environment that combines workstation power with versatile networking.
- Chapter 2 describes Digital's DECstation and VAXstation products. Descriptions cover the enclosures, graphics controllers, peripherals, and communications. Servers are described and positioned in terms of performance and computing requirements. Product Selection Charts offer a guideline for defining the correct mix of Digital workstations, servers, and applications.

- Chapter 3 describes the importance of standards and Digital's role in fostering standard interfaces, protocols, and languages.
- Chapter 4 introduces DECwindows, Digital's desktop windowing architecture. DECwindows software is based on the industry-standard X Window System and is designed for use in the ULTRIX, VMS, and MS-DOS operating environments.
- Chapter 5 describes the VMS and ULTRIX operating environments. Both operating systems allow participation in Digital and other networks.
- Chapter 6 describes Digital's multivendor networking. Some of the areas discussed are Local Area VAXcluster Systems, the Digital Network Architecture (DNA), the Transmission Control Protocol/Internet Protocol (TCP/IP) networking protocol, and the Network File System (NFS).
- Chapter 7 details the services that Digital provides to customers: software and hardware support; user training; the Application Centers for Technology, where customers gain firsthand exposure to Digital's products and expertise; and Cooperative Marketing Programs—joint agreements between Digital and other vendors who together supply a diverse range of application software.
- Chapter 8 lists approximately 275 applications that run on Digital's workstations.
- Appendixes A through C offer summary and reference material.
- The glossary defines technical terms used in this book.

This technical summary should answer most questions about Digital's workstation products. For additional information, contact a sales representative. Digital's offices are located in more than 650 sales and service sites worldwide. Check the telephone directory for the nearest location.

## **Chapter 1 • Desktop Solutions**

Digital's desktop strategy is very simple. It is designed to connect users to the resources they need to accomplish their work.

Digital offers a complete range of desktop systems, from terminals to one of the fastest desktop workstations in the world. And, whether it's a VMS, UNIX, or MS-DOS system, DECwindows software provides the common user interface.

DECwindows is the result of the largest software development effort in Digital's history. With DECwindows, all the power of integration comes to the desk, backed with the commitment to industrywide standards.

### **• Digital's Approach to Desktop Computing**

Digital provides leadership desktop solutions for whatever style of computing our customers need.

Many customers want a simple terminal. It gives them all the access to computing they need. For these customers, we currently offer our VT300 series of terminals.

For customers who are primarily interested in using personal computers and MS-DOS, we offer the DECstation family of industry-standard personal computers. With our award-winning PC integration products, we can connect our PCs and the PCs sold by many other vendors.

For customers who want high-performance VAX workstations, Digital has developed a wide range of VAXstation products that run the VMS and UNIX operating systems. Through hardware servers and software emulation, we can also provide cost-effective MS-DOS capabilities to our VAXstation users.



Some customers require very high-performance UNIX workstations. Digital offers them the DECstation 3100—a RISC-based, UNIX workstation that is now one of the fastest desktop workstations in the world.

Desktop system users should be able to spend their time on valuable, productive work—not on trying to master divergent, dissimilar user interfaces. Digital enables them to do this through DECwindows—the single, unifying interface that runs on all of our desktop systems. Through software products that adhere to the Compound Document Architecture and through hundreds of third-party applications, Digital offers customers the tools they need to get their jobs done. And, of course, all of Digital desktop systems can be connected through Digital's network products.

### ■ Continuity in Architecture

Digital is the only computer manufacturer to provide the flexibility of a system architecture that extends from the desktop to the data center. Digital's system architecture defines layered components, as well as interfaces between those components. This ingenious approach enables Digital to support and develop new computing solutions, and provides consistency among the system components in which you have already invested.

With a consistent approach to networking, distributed computing, and application integration, Digital can introduce new technology at any level of the architecture, while all of the components continue to work together. Whether you are planning to use VAX or RISC-based systems, Digital provides you with the highest possible interoperability from the desktop to the data center.

From the desktop to the mainframe, Digital's architecture can be tailored to meet the unique application requirements of both the individual user and the organization.



- **Matching Computing Environments to Applications**

The ability to deliver the best of time-share and distributed computing solutions in an open network computing environment has made Digital the world's leading manufacturer of networked computer systems and services.

Through an open network environment, desktop computing users can have dedicated resources available on their desktop, and at the same time can have access to all other resources in the enterprisewide computing environment. Users can access applications that run on VMS and ULTRIX operating systems from anywhere on the network. Resources on the network are exactly like resources at the desktop. The application interface is consistent across all platforms and makes accessing information as easy as possible.

- **Protecting and Maximizing Your Computing Investment**

Digital's Network Application Support (NAS) provides the framework for an open computing environment and enables organizations to protect and maximize their computer investments. Digital's NAS services enable common applications access, business communications, and information and resource sharing across multiple desktops from Digital and other vendors. Users of these devices can work together in a unified systems environment to access information, application-to-application and worker-to-worker. They can also access information in mainframe applications via DECnet/OSI gateways to Cray supercomputers and IBM/SNA networks.

- **Leadership Solutions for Every Style of Computing**

Digital provides desktop users with leadership solutions on the desk and beyond and enables them to easily expand these solutions without jeopardizing their current investments.

Digital provides solutions for every style of desktop computing:

- Leadership terminals and timesharing systems for simple word processing, mail, and data entry
- MS-DOS based personal computers
- Fast and efficient RISC-based ULTRIX workstations for complex simulation and modeling
- An entire range of high-performance workstations based on VAX systems for diverse workloads

Digital can satisfy your computing requirements regardless of the operating system you chose. Digital offers VMS applications, UNIX applications, and MS-DOS applications. Through Local Area Networks and Network Application Support, Digital can link the user to the enterprise information network anywhere, anytime.

### ▪ Workstation Concepts

Digital's workstations are for professional use in technical and commercial environments that require a bit-mapped desktop system. Traditional application areas include: CASE, mechanical and electrical CAD, and research, as well as innovative business and office applications.

Desktop publishing and financial analysis are two areas, for example, where a workstation's combination of graphics and processing power makes it a superior solution to conventional terminals and centralized systems.

### ▪ Open Standards

Digital's goal of achieving true transparent integration of applications across multivendor platforms depends on the degree to which standards are adopted throughout the industry and applications are upgraded to take advantage of those standards. Digital works actively with key hardware and application vendors as well as standards committees to help bring truly integrated solutions to the customer. Digital follows a well-established, consistent, and conscientious

process of standards development and compliance. Digital has made a commitment to adhere to standards such as UNIX/OSF, POSIX, OSI, and the X Window System. (See the discussion and description of standards in Chapter 3).

Digital's approach to standards adds a unique dimension to workstation capabilities and performance. Digital's workstations bring all the resources of the organization to the desktop through the network. With Digital's workstations running DECwindows software, you have the capability of linking all the computers in your organization today—not only VMS and ULTRIX systems, but MS-DOS systems as well.

### • Networks

Because Digital's workstation family uses our industry-leading networking capabilities, you gain increased computing power and capacity at every desktop throughout your organization. You no longer need large amounts of local storage for each workstation. You can store and manage your operating system, windowing software, data, and applications centrally.

Users in a distributed computing environment gain more time to do productive work because the system maintenance associated with individualized workstations is done locally. All of the systems can be managed from a single desktop workstation. Individual workstation users are completely free from routine maintenance tasks.

### • Applications

Digital's family of versatile desktop workstations is designed to support both general-purpose and specialized software requirements. Users at all levels of your organization can take full advantage of the wealth of VMS and ULTRIX software applications, as well as the thousands of applications available on MS-DOS.



Digital's workstation family takes the best application features of VMS and ULTRIX operating systems and makes them even better. By using DECwindows, VAX/VMS, VAX/ULTRIX or RISC/ULTRIX, you can design applications to exchange data between workstations, regardless of hardware differences.

Digital's family of workstations will enable every member of your organization to easily link their ULTRIX and VMS systems and applications in a heterogeneous operating system environment. This means additional savings to you through reduced application maintenance and systems management, no additional operating investments, and no costly software conversions.

Digital is aggressively working with industry leading software vendors to provide the application solutions to meet your specific workstation requirements.

## Chapter 2 • Desktop Systems, Servers, and Applications

The more you know about workstations, the better prepared you will be to make the proper computing choice. To help you in your selection process, this chapter examines key attributes of Digital's workstation computing environments. Workstations, servers, and applications are detailed and positioned in terms of performance and computing requirements.

The new DECstation family includes the DECstation 3100, a workstation with an ULTRIX operating system based on *Reduced Instruction Set Computer (RISC)* technology. ULTRIX is Digital's enhanced version of the UNIX operating system.

The VAXstation family includes a range of compatible workstations based on the VAX family of microprocessor systems. All VAXstation members can run either the ULTRIX or VMS operating system.

All of Digital's personal computers and workstations can participate fully in Digital's enterprisewide networking environment.

Each workstation is a complete system configured with video display monitor; video controller; memory; central processor; floating-point processor; cabling; Ethernet controller; ports for Ethernet, printer, and modem connection; hardware documentation; software licenses; and warranty. The systems are expandable with many storage and other options.

## ▪ **The DECstation Family**

The new DECstation workstation family is based on industry standards. The family includes a high-end workstation that runs the ULTRIX operating system. Regardless of the operating system and the architecture, all Digital personal computers and workstations can be networked, seamlessly.

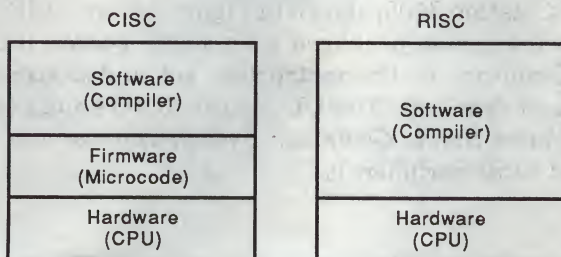
## ▪ **Reduced Instruction Set Computer (RISC) Technology**

Over the past ten years, RISC has emerged as a technology based on the concept that performance can be achieved through simplicity in the architecture. The goal of RISC (Reduced Instruction Set Computer Technology) designers is to increase processor performance. This performance advantage is accomplished in a variety of ways including VLSI, CPU organization, system-level architecture, operating system considerations, and compiler design. There is no agreed upon RISC standard. Each RISC implementation on the market today is different from the others. Some RISC designs are more effective than others in a given application environment.

The RISC microprocessor is typically designed to support a small set of instructions with simpler addressing modes. Speed advantage is achieved by implementing a register-intensive load/store architecture where all computations are expected to be performed between registers. Only these load/store instructions access main memory. There is a very large set of registers, since most register operations can be performed in one cycle. The optimum RISC machine would achieve a one cpi (cycle per instruction) rating. High-level compilers synthesize the more complex, least frequently used instructions by breaking them down into simpler instructions. This approach allows the RISC architect to implement a small, hardware-assisted instruction set, thus eliminating the need for microcode. The compiler is responsible for generating a set of simple instructions that replace the functions previously supplied by microcode.



RISC architectures generally require more memory to hold a given program. Early RISC architecture generated much more machine code than CISC (Complex Instruction Set Computer) architecture because complex instructions were broken down into many simple instructions. More recent RISC methodologies have used optimizing compilers that incorporate sophisticated techniques to minimize program length. Some operating systems have been modified to manage memory more efficiently on RISC-based systems. These techniques have helped cut down the RISC memory requirement. Figure 2-1 compares RISC and CISC technologies.



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*Figure 2-1 • Comparison of RISC and CISC Technologies*

RISC architectures rely heavily on cache memory to increase power. Cache memory resides on the CPU chip and/or the CPU board. It behaves like system memory except that it allows instructions and data to be retrieved significantly faster. RISC requires high bandwidth memory to achieve greater performance. Improved memory technologies such as cache controllers, memory controllers, and greater memory density enable the designer to achieve this performance goal.

Some RISC designers also incorporate such techniques as delaying instruction loading, instruction pipelining, and branching.

Computer vendors are currently working on improvements to their products based on both RISC and CISC technologies. It is impossible to predict today whether one technology will dominate the other. At the same time, it is clear that they both will affect our future computing needs.

Appendix C lists additional reading about RISC.

#### • DECstation 3100

The DECstation 3100, shown in Figure 2-2, is a RISC-based UNIX workstation packaged on a single board. RISC provides simplicity in the instruction set and a streamlined microprocessor chip. The DECstation 3100 supports an external, open *Small Computer System Interconnect (SCSI)* bus and SCSI peripherals.



*Figure 2-2 • The DECstation 3100*



## ▪ **DECstation 3100 Description**

The DECstation 3100 represents Digital's first use of RISC technology. The workstation offers 14 times the processing speed of the VAX-11/780 and can operate as a full member of either a UNIX or VMS networked computing environment.

The high performance of the DECstation 3100 comes from the RISC R2000 CPU and R2010 Floating Point Unit developed by MIPS Computer Systems, Inc. The Floating Point Unit delivers 3.7 megaflops single-precision and 1.6 megaflops double-precision floating point performance.

The DECstation 3100 workstation follows industry standards, from the UNIX operating system to the open SCSI (Small Computer Systems Interconnect) bus and SCSI peripherals. The DECstation 3100 uses Digital's new SCSI storage devices including the RZ23 and RZ55 disks, and the TZ50Z tape drives.

The workstation is available in both monochrome and 8-plane color configurations, and with a choice of 38.1-cm (15-inch) or 47.0-cm (19-inch) monitors.

The following standard software is packaged with the DECstation 3100 system:

- The ULTRIX-32 operating system
- An optimizing C compiler
- DECwindows based on the X Window System Version 11
- X User Interface (XUI)
- TCP/IP and Network File System (NFS) networking software

Optional products include a FORTRAN compiler with VAX/VMS extensions and DECnet-ULTRIX gateway software.

- *CPU and FPU Chips for the DECstation 3100*

The DECstation 3100 processor includes a MIPS Computer Systems, Inc. R2000 RISC CPU chip, R2010 Floating Point Unit (FPU), and the R2020 write buffers. The R2000 chipset operates at 16.67 MHz, resulting in an average processor performance that is 14 times faster than the VAX-11/780 over a range of applications. The R2000 implements an integer format compatible with the VAX processor.

The R2010 FPU conforms to the ANSI/IEEE Standard format for Binary Floating Point Arithmetic. The floating point unit provides a 3.7 megaflops single precision and 1.6 megaflops double precision. The DECstation 3100 is characterized by well-balanced integer and floating point performance. The floating point unit is standard.

The DECstation 3100 CPU has a 4-Gbyte virtual address space. The physical memory system has two main components: cache memory and system memory.

The cache memory was designed with separate instruction and data caches; its contents are maintained by the CPU to ensure optimum performance. The instruction cache is a 64-Kbyte, direct-mapped cache and the data cache is a 64-Kbyte, direct-mapped, write-through cache. Both caches are accessed within a single CPU cycle.

The DECstation 3100 system has parity memory expandable to 24 Mbytes using 4-Mbyte memory options. The minimum memory configuration is 8 Mbytes.

- *DECstation 3100 System Module*

The synchronous, 4-Mbyte-per-second, Small Computer System Interconnect (SCSI) is the general-purpose I/O interconnect. The SCSI interconnect supports Digital's 104-Mbyte RZ23, a 3 1/2-inch internal SCSI disk intended for use as a swapping disk in an NFS environment. In addition, Digital's 95-Mbyte TK50Z, 1/2-inch SCSI cartridge tape and

the 332-Mbyte RZ55, 5 1/4-inch SCSI disk are supported in external enclosures.

The DECstation 3100 LAN network interface is compatible with both IEEE-802.3 and Ethernet. You can connect the DECstation 3100 to a LAN using a switch-selectable thickwire or ThinWire connection.

▪ *DECstation 3100 Graphics Subsystem*

The graphics interface for the DECstation 3100 workstation has the following components:

- A color mask
- Color or monochrome frame buffers
- A programmable cursor chip
- Video digital-to-analog converters (VDACs)
- Monitors

The color mask allows the processor to write to the color frame buffer and to affect only specific bits of a pixel. The color plan mask applies to all four pixels in a given word of the frame buffer.

The color frame buffer option contains a 1024 x 864, 8-plane frame buffer. The buffer appears as a 256-Kbyte x 32-bit region of main memory in the processor's address space. The frame buffer is organized as a 1024 x 1024 pixel buffer, of which only 1024 x 864 pixels are displayed.

The programmable cursor chip provides the following functions: a 16 x 16-pixel, 2-plane cursor, and two programmable active region detect interrupts.

The VDAC has a 256 x 24-bit color lookup table with triple 8-bit video D/A converters. The VDACs support a standard CPU bus interface that allows the CPU direct access to the color palette RAM and overlay color registers.



The monitors have a displayable resolution of 1024 x 864 pixels and have a noninterlaced 60-Hz refresh rate. Either a 38.1-cm (15-inch) or a 47.0-cm (19-inch) color or monochrome monitor is available.

## ▪ **The VAXstation Family**

The VAXstation family comprises the following workstations:

- VAXstation 2000
- VAXstation 3100
- VAXstation 3200
- VAXstation 3500
- VAXstation 3520/3540

The workstations are members of the VAX family and share a common architecture. They are based on Digital's chip implementation of the VAX architecture.

MicroVAX systems are compatible with all other VAX family members: all members of the VAXstation family can run either the VMS or the ULTRIX operating system. Special-purpose graphics hardware and software support the transition from a powerful microcomputer system to a self-contained workstation. Upgrades are available to convert an existing MicroVAX 3500 system into a graphics workstation.

You can use the workstations with or without disks, standalone, in VAXcluster Systems (for VMS based systems), and in networks (for VMS and ULTRIX based systems). (A NI-based VAXcluster system allows up to 41 workstations, connected by Ethernet, to share computation and storage facilities.) This section describes each VAXstation member. Table 2-1, later in this chapter, summarizes the VAXstation family features. Contact a Digital sales representative for details about any VAXstation configuration.

### ▪ VAXstation 2000

The VAXstation 2000 system is packaged on a single board in the compact system box shown in Figure 2-3. Expansion boxes support additional data storage options.



*Figure 2-3 • The VAXstation 2000*

### ▪ VAXstation 2000 Description

The VAXstation 2000 is Digital's lowest-price entry-level workstation, offering economical graphics performance and processing power. The system is packaged in a single enclosure that houses the MicroVAX II central processor, floating-point processor, memory, a controller for Winchester and diskette drives, a controller for the TK50 tape drive, an Ethernet controller and transceiver, and four ports supporting keyboard, mouse, modem connection, and printer or plotter.

The VAXstation 2000 workstation is available with or without disks. Four video display monitors are available:

monochrome and color in either a 38.1-cm (15-inch) or 47.0-cm (19-inch) model. An optional VLSI coprocessor offloads graphics processing from the central processor and allows gray-scale graphics with a monochrome monitor or color graphics with a color monitor.

The workstation is designed for technical, scientific, financial trading, and advanced office applications, such as desktop publishing, drafting, and computer-aided software engineering.

• *CPU and FPU Chips for the VAXstation 2000*

The CPU (78032) chip is a 32-bit virtual memory microprocessor that implements a central processor compatible with the VAX system, including the VAX basic instruction set, demand-paged memory management, translation buffer, and 32-bit internal/external data path. Hardware executes most of the VAX instruction set. The remaining infrequently used instructions are emulated in software or by the FPU chip, giving support for the total instruction set. At its maximum frequency, the CPU chip achieves a 200-nanosecond microcycle and a 400-nanosecond I/O cycle. Full memory management is provided for both instruction and data references.

The FPU (78132) chip implements a floating-point unit compatible with the VAX system; the unit performs fast floating-point calculations. Three data paths, each controlled by microcode, work in parallel to yield a 100-nanosecond microcycle and a 200-nanosecond I/O cycle. The wide data paths accommodate a variety of instructions, using microwords of 35 bits for control.

Together, the chips support most VAX data types, including byte, word, longword, quadword, character string, variable-length bit field, `f_`, `d_`, and `g_` floating-point data types in hardware. The `h_` floating-point data type is supported in software.



- **MicroVAX 2000 System Module and Controllers**

The MicroVAX 2000 system module provides a 40-MHz clock, a time-of-year clock with battery backup, two Mbytes of onboard memory, and a 256-Kbyte bootstrap/diagnostic read-only memory. Three built-in option connectors allow the connection of a memory expansion module (providing up to 12 Mbytes of additional memory), a thickwire or Thin-Wire Ethernet adapter, and a 4 or 8-plane color video option. Four serial ports are provided for printer, mouse, RS423 modem support, and keyboard devices. The system has no buses; it uses a 32-bit data path for internal system communication.

Controllers for diskettes and Winchester disks are built into the MicroVAX 2000 system module; expansion boxes support storage options.

- **VAXstation 3100**

The VAXstation 3100 is a desktop VAX computer. It supports native VMS and native ULTRIX operating systems and the MS-DOS system through emulation. It has an open systems architecture that supports a SCSI bus, the DECwindows interface, Mailbus X.400, and OSI-compliant DECnet software. The VAXstation 3100 is shown in Figure 2-4.



*Figure 2-4 ■ The VAXstation 3100 (Model 30)*

## • VAXstation 3100 Description

The VAXstation 3100, which is both an entry-level workstation and a powerful networked personal computer, puts a VAX computer on a desktop.

It uses Digital's new SCSI storage devices including the RZ22, RZ23, RZ55 disks, the TZ30 AND TK50Z tape drives, and the RRD40 compact disk drive.

Combining the ease of use of a personal computer with the power and functionality of a workstation, the VAXstation 3100 can access VMS, UNIX, ULTRIX, and MS-DOS applications simultaneously on the same screen using DECwindows. DECwindows, Digital's implementation of the industry-standard X Window System, provides a consistent user interface for all applications.

The VAXstation 3100 system offers either an ULTRIX or VMS operating system. With either operating system, the common VAX architecture simplifies the task of integrating VAXstation 3100 systems with other VAX systems in a networked environment. An optional MS-DOS software co-processor runs unmodified PC applications, which enables customers to run MS-DOS applications.

The VAXstation 3100 uses a CMOS CPU, also found on Digital's VAXstation 3200, VAXstation 3500, and VAXstation 3520/3540 systems. (CMOS stands for advanced complementary metal-oxide semiconductor technology.)

Both single-plane monochrome and eight-plane *gray-scale* or color systems are offered. Monochrome and color monitors are available in 15- and 19-inch sizes.



- *CPU and FPU Chips for the VAXstation 3100*

The VAXstation 3100 system uses Digital's proprietary CMOS microprocessor, the 78034, and the CVAX 78134 floating-point unit chip. CPU performance is increased by the two-level, write-through cache architecture. In addition to a 1-Kbyte cache in the CVAX chip, there is a second-level 32-Kbyte cache on the CPU board.

The CVAX CPU chip is a 32-bit microprocessor that implements the VAX architecture, achieving a 90-nanosecond cycle time.

- *VAXstation 3100 System Module and Controllers*

The VAXstation 3100 system module provides a 44-MHz system clock, a time-of-year clock with battery backup, four Mbytes of onboard memory, and a 256-Kbyte bootstrap/diagnostic read-only memory. Three built-in option connectors allow the connection of a memory expansion module (providing up to 32 Mbytes of total memory), disk controllers, and a color video option. Four serial ports are provided for printer, mouse, modem, and keyboard devices. The system uses a 32-bit data path for internal system communication.

The Ethernet controller is integral to the CPU board, which supports switch-selectable ThinWire and thickwire Ethernet.

## ▪ VAXstation 3200

The VAXstation 3200 system provides an 8-slot Q-bus backplane and two 5 1/4-inch mass storage cavities for disk and tape drives. Figure 2-5 shows a VAXstation 3200 pedestal model that can sit under or beside a desk.



*Figure 2-5 • The VAXstation 3200*

## ▪ VAXstation 3200 Description

The VAXstation 3200 system is based on Digital's CMOS-based MicroVAX central processing unit and floating-point unit chipsets. The VAXstation 3200 is packaged in the compact desk-side BA23 enclosure with up to 16 Mbytes of system memory. It is available with or without disks.

A graphics coprocessor handles text and graphics processing, which increases system performance. The coprocessor performs a variety of raster operations in hardware. The workstation is offered with either monochrome or color monitors. You can order either a 4-plane or an 8-plane configuration. Figure 2-5 shows a VAXstation 3200 in the BA23 enclosure.

Offered with either the VMS or ULTRIX operating systems, the VAXstation 3200 is an ideal networked workstation for VAXcluster Systems or NFS environments. The VAXstation 3200 workstation is designed for applications such as financial trading, mechanical and electrical computer-aided design, artificial intelligence development, molecular modeling, and reservoir simulation.

• *CPU and FPU Chips for the VAXstation 3200 and VAXstation 3500*

The VAXstation 3200 and the VAXstation 3500 family members, described next, use Digital's proprietary CMOS microprocessor, the 78034, and the CVAX 78134 floating-point unit chip. CPU performance is increased by the two-level, write-through cache architecture. In addition to a 1-Kbyte cache on the CVAX chip, there is a second-level 64-Kbyte cache on the CPU board. The CPU board also includes custom VLSI CMOS chips for Q-bus interface, memory control, and auxiliary functions.

The CVAX CPU chip is a 32-bit microprocessor that implements the VAX architecture. It achieves a 90-nanosecond cycle time. The VAXstation 3200 and VAXstation 3500 systems use ECC main memory of from 16 Mbytes (VAXstation 3200) to 32 Mbytes (VAXstation 3500). Each 8-Mbyte memory module uses 256-Kbyte ZIP dynamic RAM.



▪ **VAXstation 3500**

The VAXstation 3500 BA213 enclosure provides a 12-slot quad-height Q-bus backplane to allow for system options and three 5 1/4-inch cavities for mass storage. The cavities can hold a TK70 cartridge tape drive and up to two RA70 disk drives. Figure 2-6 shows a VAXstation 3500 system housed in a pedestal enclosure that fits under or beside a desk.



*Figure 2-6 • The VAXstation 3500*

## • VAXstation 3500 Description

The VAXstation 3500 is a high-performance color workstation designed for compute-intensive graphics applications. It is based on Digital's CMOS-based MicroVAX central processing unit and floating-point unit chipsets. The workstation can have up to 32 Mbytes of system memory.

Available with either the VMS or ULTRIX operating system, the VAXstation 3500 can join a VAXcluster System or an NFS environment or be used as a standalone system. The RA70 disk drive for storage is standard on the VAXstation 3500. The RA70 holds up to 280 Mbytes. (One more RA70 may be added.) A TK70 provides standard tape backup. A TK70 offers 296 Mbytes of storage.

A graphics coprocessor handles text and graphics processing, which increases system performance. The coprocessor performs several raster operations in hardware, including fast bit-block transfer. You can order the VAXstation 3500 in either a 4- or an 8-plane configuration.

The VAXstation 3500 workstation, like the VAXstation 3200, is particularly useful for applications such as financial trading, mechanical and electrical computer-aided design, artificial intelligence development, molecular modeling, and reservoir simulation.

▪ **VAXstation 3520/3540**

The VAXstation 3520/3540 is a multiprocessor workstation that supports DECwindows software for 2D and 3D graphics applications. Figure 2-7 shows a VAXstation 3540, which is housed in a pedestal model.



*Figure 2-7 • The VAXstation 3540*



## • VAXstation 3520/3540 Description

The VAXstation 3520/3540, designed for 2D and 3D applications, is a fully compatible member of the VAXstation family. This multiprocessor workstation achieves excellent system balance through a new internal bus, a new I/O subsystem, and a new 3D graphics subsystem. It delivers up to ten times the performance of the VAX-11/780 system.

This multiprocessor workstation is one of the first to fully integrate 2D and 3D graphics standards, imaging, and windowing systems. This means you can use the same workstation for mail and document preparation that you use to do your graphics work.

Digital leads the industry in developing graphics standards and in offering products built on standards. The VAXstation 3520/3540 is the first workstation to offer 3D graphics in a networked window environment through a fully compliant version of the PEX specification. PEX (PHIGS/PHIGS+ extension to X) is an industry-standard interface for 3D applications.

The VAXstation 3520/3540 system can expand as your needs grow. You can have up to 64 Mbytes of memory (on the VAXstation 3520) and add as many as four 332-Mbyte (formatted) SCSI disks, which provides over 1.3 Gbytes of storage. With an optional Q-bus adapter module, you can support three Q-bus options. There are connectors for switch-selectable ThinWire and thickwire Ethernet and two serial lines.

Like all of Digital's workstations, this true color system can operate as a single-user design center, in a VAXcluster System, in a Local Area Ethernet environment, or in a multivendor environment.

For 3D applications, the VAXstation 3520/3540 is a high performance workstation. The system supports DECwindows, DEC GKS software for 2D applications, and supports PEX through DEC PHIGS software for 3D applications.

### • *Difference Between the VAXstation 3520 and the VAXstation 3540*

The VAXstation 3520 system has two processors and is available with either the VMS or ULTRIX operating system. The VAXstation 3540 has four processors and is available with the VMS operating system. Memory expansion is limited to 48 Mbytes with the VAXstation 3540. A 19-inch high-resolution color monitor (1280 x 1024 pixels) is standard at 66-Hz refresh rate with both.

### • *CPU and FPA Chips for the VAXstation 3520/3540*

Each CPU module contains two CVAX CPU and FPA (floating point) chips. The CVAX is a single-chip, pipelined implementation of the 32-bit VAX architecture in CMOS. The VAX architecture has a 4-Gbyte virtual address space, and the CVAX supports a 1-Gbyte physical address space. Each CPU chip has a 1-Kbyte internal cache and a 64-Kbyte external cache. These high speed caches are especially important because the speed of the dynamic memories used in the main memory lags behind the increases in CPU performance.

The CVAX chip contains the memory management unit that performs the virtual to physical address translations, memory protection, and page fault generation. It includes a 28-entry translation buffer to cache recent address translations. A virtual-to-physical translation is performed each time the CPU generates an address, so it is critical to remember as many previous translations as possible.

Each CPU card contains two identical CPU subsystems. The bus interface provides the necessary support to ensure synchronization among all the processors.

The multiprocessor architecture adds a new level of complexity to system design. All of the processors in the system must be synchronized when accessing shared data. In simple architecture without caches, this can be accomplished



with interlocked instructions. Interlocked instructions perform both a read and a write of memory without allowing other processors access to memory until the instruction completes.

Although the solutions are much more difficult when caches are introduced, caches are necessary because CPU speed has increased much more quickly than memory speed. This growing performance gap mandates the use of caches with high speed CPUs to reduce the demand on main memory. Each CPU in the VAXstation 3520/3540 system has a two-level cache. The CVAX chip has an internal 1-Kbyte two-way set-associative, write-through cache. It can be configured to cache the instruction and/or data streams.

Each CPU also has an external 64-Kbyte direct mapped cache (a total of 128-Kbyte per dual-CPU module).

Since processors share data in a multiprocessor environment, the same piece of data may be in more than one processor's cache at the same time. If one processor modified the data, the other cache has to be updated to reflect the new data. If the caches are write-through, every CPU write updates not only the processor's cache memory, but also the main memory. If another cache has a copy of the data, it typically invalidates the entry. The write-through scheme results in unnecessary writes to main memory.

To avoid this problem, the VAXstation 3520/3540 system uses a write-back scheme, which is more efficient than write-through. A write-back cache does not generate a write to main memory during a CPU write. A write to main memory occurs only when a modified cache entry has to be used to cache another memory-location, with one exception. Since the VAXstation 3520/3540 has multiple CPUs, a "snoopy" algorithm is used to maintain consistency across caches. If more than one cache is sharing the same data, every CPU write to that location generates a write to main memory. The other caches snoop on the M-bus while still



maintaining consistency across all caches. The performance gains justify the added complexity of this scheme.

## ▪ VAXstation Graphics Subsystem

The VAXstation graphics subsystem consists of the *video display monitor (CRT)*, video device controller, and, for the color subsystems, a graphics coprocessor. The main function of the graphics subsystem is to process, display, and manipulate graphics data structures.

For 3D graphics, the VAXstation 3200 and VAXstation 3500 use software; the VAXstation 3530/3540 uses hardware and software.

## ▪ Monitors

All VAXstation systems except the VAXstation 3520/2540 use either a 38.1-cm (15-inch) or a 47.0-cm (19-inch) video display monitor that provides excellent viewing space and resolution for multiwindowing and graphics work. The monochrome and gray-scale monitors (VR150 and VR260) and the color monitors (VR160 and VR290) each support a resolution of 1024 x 864 pixels. All monitors use a 60-Hz noninterlaced refresh rate that reduces *flicker* and picture smear. The VAXstation 3520/3540 uses a new, high-resolution monitor (VR295). It has a resolution of 1280 x 1024 pixels and a 66-Hz noninterlaced refresh rate.

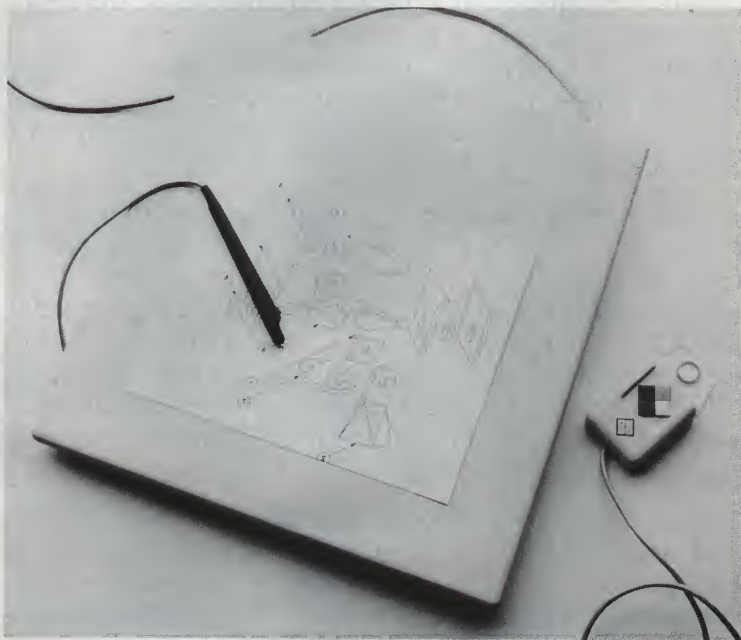
The VAXstation 3520/3540 uses only the high resolution, 47.0 cm (19-inch) color monitor (VR295) with a resolution of 1280 x 1024 and a 66-Hz noninterlaced refresh rate.

## ▪ Mouse, Keyboard, and Tablet

Each VAXstation system has a 3-button *mouse*, which controls the movement of a pointer on the monitor screen and performs other functions determined by the workstation software. The workstations use Digital's LK201 detachable keyboard with 105 sculptured keys, typewriter-style

main array, editing keypad, numeric keypad, and 15 special-function keys.

All VAXstation systems support an optional 11-inch x 11-inch graphics tablet as an alternative to the mouse. The graphics tablet, shown in Figure 2-8, includes the tablet itself and an interchangeable 4-button puck or 2-button stylus. The graphics tablet can be used for menu selection, graphics entry, and cursor control.



*Figure 2-8 • Tablet Subsystem*

### • Video Device Controllers

The *video device controller* is the system component that stores graphics information and generates graphics images on the video screen. Two video-device-controller architectures are supported: one for monochrome and one for color and gray-scale.

The monochrome video controller, used with the VR260 monochrome display, provides a 1024 x 2048 single-plane array of bitmapped memory, called the *frame buffer*. The screen is mapped from a 1024 x 864 portion of the frame buffer; the remainder is offscreen memory and can be used for other functions. The frame buffer is accessed by the MicroVAX processor to manipulate graphics and text and to control cursor movement. All graphics operations are performed by the CPU.

The color video controller, a sophisticated multiplane controller for the VR260 gray-scale and VR290 color monitors, uses parallel processing to manipulate up to four (1024 x 2048) bitplanes simultaneously on the VAXstation 2000, 3100, 3200, and 3500 systems. For each bitplane, a video processor chip performs raster functions, such as *polygon fill*. An address processor chip coordinates the timing of the video processor chip and performs global operations, such as clipping, for all planes.

The color video controller communicates with the MicroVAX processor through a DMA interface and can access display lists stored in the CPU's main memory. The processor does not write directly to graphics memory; instead, a coprocessor performs all drawing operations.



- *Graphics Coprocessor for the VAXstation 2000, 3100, 3200, and 3500*

The color and gray-scale versions of the VAXstation 2000, 3100, 3200, and 3500 systems use a graphics coprocessor to perform low-level graphics operations, allowing the system to conduct graphics and general processing concurrently. By executing a display list of sequences of primitive graphics operations, the CPU addresses the graphics coprocessor only once instead of several times.

The graphics coprocessor performs a range of raster operations in hardware, including:

- Fast bit-block transfer with *rotation*, fractional scaling, and Boolean operations
- Vector and text drawing
- Hardware *clipping*, tiling *stippling*, and *pattern fill*
- Smooth scrolling in both vertical and horizontal planes

The graphics coprocessor also resolves conflicts resulting from the interaction of many processes, such as CRT refresh, scrolling, and screen updates. Screen updates are performed on all planes in parallel, allowing excellent system performance compared to other conventional graphics architectures.

The graphics subsystem is housed on a single board for the 4- or 8-plane VAXstation 2000. The VAXstation 3100 offers an 8-plane graphics coprocessor. The graphics subsystem is housed on three Q-bus modules for a VAXstation 3200 or VAXstation 3500 system.

• *Graphics Coprocessor for the VAXstation 3520/3540*

To attain real-time dynamics of 3D objects on the VAXstation 3520/3540 system, Digital designed a new graphics system. The new architecture includes:

- 8 or 24 bits-per-pixel (planes)—256 or 16.8 million simultaneous colors.
- 2048 x 2048 pixel frame buffer—1280 x 1024 screen resolution. The remaining memory is available for 24-bit double buffering and Z buffering. Can do full double-buffering and Z buffering simultaneously.
- 66-Hz noninterlaced refresh rate. Flicker-free operation.
- Geometry transformation engine. Real-time 3D manipulation of objects.
- Parallel operation on all planes. No performance degradation when more planes are added.
- Flat and Gouraud shading.
- Multiple light sources.

## ▪ Workstation Features

Table 2-1 lists the major features supported by each Digital workstation.

Table 2-1 ▪ Workstation Features							
VAXstation	2000	3100	3200	3500	3520	3540	
DECstation							3100
System Display							
Monochrome	yes	yes	—	—	—	—	yes
Gray scale	yes	yes	yes	yes	—	—	—
Colors	yes	yes	yes	yes	yes	yes	yes
Max. simultaneous colors	256	256	256	256	16.8 million	16.8 million	256
Monitor Size/Type							
38.1-cm 15-inch color VR160	yes	yes	yes	—	—	—	yes
38.1-cm 15-inch monochrome VR150	yes	yes	—	—	—	—	yes
47.0-cm 19-inch color VR290	yes	yes	yes	yes	—	—	yes
47.0-cm 19-inch monochrome VR260	yes	yes	yes	yes	—	—	yes
47.0-cm 19-inch color VR295	—	—	—	—	yes	yes	—
System Memory							
Maximum	14MB	32MB	16MB	32MB	64MB	64MB	24MB



Table 2-1 (Cont'd.) • Workstation Features

VAXstation	2000	3100	3200	3500	3520	3540	
DECstation							3100
Max. Storage							
Diskless	yes	yes	yes	—	yes	yes	yes
44-Mbyte disk RD32	yes	—	—	—	—	—	—
52-Mbyte disk RZ22	—	yes	—	—	—	—	—
71-Mbyte disk RD53	1-2	—	1-3	—	—	—	—
105-Mbyte disk RZ23	—	2	—	—	—	—	2
159-Mbyte disk RD54	2	—	4	—	—	—	—
280-Mbyte disk RA70	—	—	—	1-2	—	—	—
332-Mbyte disk RZ55	—	7	—	—	4	4	7

Table 2-1 (Cont'd.) • Workstation Features

VAXstation	2000	3100	3200	3500	3520	3540	
DECstation							3100
<b>Removable Media</b>							
1.4-Mbyte diskette RX23	—	yes	—	—	—	—	—
1.2-Mbyte diskette RX33	yes	—	yes	—	—	—	—
.45-Mbyte disk RX50	—	—	yes	—	—	—	—
95-Mbyte tape TK50	yes	yes	yes	—	—	—	yes
95-Mbyte tape TZ30	—	yes	—	—	—	—	—
296-Mbyte tape TK70	—	—	—	yes	yes	yes	—
600-Mbyte compact disc RRD40	—	yes	—	—	—	—	—
<b>Input/Output</b>							
Gen. Purpose Ports	2	2	—	—	2	2	2
Thickwire Ethernet	yes	yes	yes	yes	yes	yes	yes
ThinWire Ethernet	yes	yes	—	—	yes	yes	yes
Full modem support	yes	—	—	—	yes	yes	—
Partial modem support	—	yes	—	—	—	—	yes
No modem support	—	—	—	—	—	—	yes
Q-bus	—	—	8	12	3	3	—
SCSI-bus	—	yes	—	—	yes	yes	yes

## • Peripheral Devices

Peripheral devices for VAXstation systems include printers, pen plotters, and storage options.

Table 2-2 lists the printers and plotters available from Digital. The workstations also support the following devices: the HP 7475, HP 7550, HP 7580, and HP 7585 plotters; the HP 7510 film recorder; the MPS-2000 film recorder; and the Apple LaserWriter.

Table 2-3 lists the storage devices for the workstations.

**Table 2-2 • Printers and Plotters**

Model	Print Speed and Quality	Graphics	Special Features
LA50	100 cps draft 50 cps memo	Sixel processing	PC-compatible Small size
LA75	250 cps draft 32 letter	Sixel processing	IBM PC-compatible Plug-in fonts Graphics
LA210	240 cps draft 40 cps letter	Sixel processing	Acoustic tractor IBM PC-compatible Plug-in fonts
LCG01	2 ppm	ReGIS, GIDIS, and NAPLS Color sixels Protocol processing Color slides	Color ink jet Offloads host
LN03	8 ppm letter	Business graphics with sixels	Collated output Plug-in RAM and font cartridges

### Key to Abbreviations

ppm—pages per minute

cps—characters per second



**Table 2-2 (Cont'd.) • Printers and Plotters**

<b>Model</b>	<b>Print Speed and Quality</b>	<b>Graphics</b>	<b>Special Features</b>
LN03 PLUS	8 ppm letter	Full bit-map graphics Business graphics with sixels	Collated output Plug-in RAM and font cartridges
LN03R	8 ppm letter	ANSI sixels ReGIS Tektronix PostScript	Collated output 29 resident fonts
PrintServer40	40 ppm	ANSI/sixels PostScript ReGIS Tektronix	Ethernet interconnect Multiple fonts
LVP16	15 in/sec	Color graphics	6-pen plotter
LJ250	16.7 in/sec	Color sixels PCL	Color ink jet

**Key to Abbreviations**

ppm—pages per minute

cps—characters per second

**Table 2-3 • Storage Devices**

<b>Part</b>	<b>Capacity</b>	<b>Peak Transfer Rate</b>	<b>Description</b>
RX50	.45 Mbyte	250 Kbit/s	Dual diskette drive
RX33	1.2 Mbyte	500 Kbit/s	Single diskette drive
RD32	44 Mbyte	5 Mbit/s (625 Kbyte/s)	Fixed disk drive
RA70	280 Mbyte	11.6 Mbit/s	Fixed disk drive
RD53	71 Mbyte	5 Mbit/s (625 Kbyte/s)	Fixed disk drive
RD54	159 Mbyte	5 Mbit/s (625 Kbyte/s)	Fixed disk drive
TK50	95 Mbyte	62.5 Kbyte/s	Cartridge tape drive
TSV05	45 Mbyte	40 or 160 Kbyte/s	Streaming tape drive
TK70	296 Mbyte	125 Kbyte/s	Cartridge tape drive
RZ22	52 Mbyte	1.25 Mbyte/s	Fixed disk drive
RZ23	104 Mbyte	1.25 Mbyte/s	Fixed disk drive
RZ55	332 Mbyte	1.25 Mbyte/s	Fixed disk drive
RX23	1.44 Mbyte	1.66 Kbyte/s	Floppy diskette
TZ30	95 Mbyte	62.5 Kbyte/s	Cartridge tape drive
TK50Z	95 Mbyte	62.5 Kbyte/s	Cartridge tape drive
RRD40	600 Mbyte	150 Kbyte/s	Compact disk
<b>Additional Storage for BA123</b>			
RA60	205 Mbyte	1.98 Mbyte/s	Removable disk drive
RA82	622 Mbyte	2.4 Mbyte/s	Fixed disk drive

## ▪ Servers

A *server* is a special purpose computer used in networks that provides specific services to client devices such as workstations, PCs, cash registers, or printers. Servers operate within a community of users and are transparent to the user.

This section discusses servers in a workstation environment and suggests areas to consider when choosing a server.

Typical services provided by servers include:

- Shared file and application storage
- Central system and data management
- Backup
- Increased CPU power
- Mixed workstation and PC integration for workgroups

Digital servers support VMS, MS-DOS, and ULTRIX operating environments.

## ▪ Single and Multifunction Servers

Servers can provide single or multifunction services. A single function server provides one service, such as file services. A multifunction server provides additional services, such as print queue management. When choosing a server, consider whether your organization requires more than one service, and what that service will be.

## ▪ DECsystem 3100 Description

The DECsystem 3100 computer can perform as a UNIX operating system server in both ULTRIX and VMS environments. The first in Digital's new family of ULTRIX computers based on RISC technology, the DECsystem 3100 can serve terminals, X Window terminals, and workstations connected to the Ethernet.



With 14 MIPS of performance, the DECsystem 3100 system can be configured in a variety of ways to support the needs of from 4 to 64 users.

The DECsystem 3100 is based on the R2000/R2010 RISC CPU/FPU chipset from MIPS Computer Systems, Inc. This processor provides 3.7 single-precision Linpack megaflops of performance. The R2010 floating point unit is standard.

### • DECsystem 3100 Highlights

- Industry-leading RISC performance—14 MIPS.
- ULTRIX—32 operating system supports the widest range of standards in the industry, including POSIX 1003.1, X/Open, and the X Window System Version 11.
- DECnet software provides integration into existing Digital environments. TCP/IP and NFS support provides easy integration into heterogeneous computing environments.
- Available configurations offer a wide range of storage and memory options to support from 4 to 64 users.
- Binary code compatibility with other members of Digital's RISC family.
- Supports up to six SCSI storage devices.

Figure 2-9 shows Digital's server systems.

Feature	PCLAN/ Server 2000	VAXstation 3100 Mod. 40	DECsystem 3100	VAXserver 3300/3400	VAXserver 3800/3900	VAX Fileserver 6300 Systems
Base System	MicroVAX 2000	VAXstation 3100 (CVAX)	DECstation 3100 (RISC)	MicroVAX 3300/3400	MicroVAX 3800/3900	VAX 6310 VAX 6320
VUPS <sup>1</sup>	.9	2.7	14	2.4	3.8	3.8 to 7.5
No. of CPUs	1	1	1	1	1	1 or 2
Maximum Storage	159 MB	1.3 GB	1.2 GB	1.5 GB/ 2.4 GB	2.4 GB/ 9.7 GB	38.8 GB (800 GB in VAXcluster)
Max. Memory	14 MB	32 MB	24 MB	52 MB	64 MB	256 MB
VAXcluster Support	Ethernet Based	LAVc	Ethernet Based Mixed Interconnect	Ethernet Based LAVc, Mixed Interconnect	Ethernet Based LAVc, Mixed Interconnect	CI Based Mixed Interconnect
# Ethernet	1	1	1	1	1	1 to 4
I/O Bus	N/A	SCSI	SCSI	Q-bus	Q-bus	VAXBI
O/S Support	VMS	VMS, ULTRIX	ULTRIX	VMS, ULTRIX	VMS, ULTRIX	VMS, ULTRIX
Clients Served <sup>2</sup>	MS-DOS PCs	VMS, ULTRIX, Workstations	ULTRIX Wkstns (boot server), UNIX Wkstns (NFS file server)	MS-DOS PCs/ VMS, ULTRIX, UNIX Wkstns/ Other I/O Devices	MS-DOS PCs/ VMS, ULTRIX, UNIX Wkstns/ Other I/O Devices	MS-DOS PCs/ VMS, ULTRIX, UNIX Wkstns/ Other I/O Devices

<sup>1</sup> VUPS = VAX Units of Performance (VAX-11/780 = 1).

<sup>2</sup> Other client environments are supported through third-party and customer interfaces.

ML0-002733

Figure 2-9 ■ Digital's Server Systems

## ▪ **Predefined Server Products**

Digital's predefined server systems are configured with the hardware and software needed to perform their particular tasks. Users do not generally modify these dedicated server systems.

Many workgroups and organizations need other network services besides boot or file services. Digital also provides communications and print servers intended for distributed processing. Communications servers are dedicated, special-purpose units that provide resource sharing across many host systems, between different networks, or within a network. These servers include gateway servers, router servers, and terminal servers. A print server is a high-speed printer that interfaces directly with the Ethernet but is under the control of a client processor node.

## ▪ **Four Special-Purpose Servers**

Digital offers four types of special-purpose servers, described below, that are available for use on an Ethernet network.

### ▪ **Terminal Servers**

- DECserver 200. Connects up to eight terminals, serial printers, or modems to one or more hosts on an Ethernet LAN.
- DECserver 500. Connects from 16 to 128 terminals, serial printers, or modems to one or more hosts on an Ethernet LAN.
- MUXserver 100/DECmux II remote terminal server. Connects up to 16 Digital terminals, PCs, or serial printers at remote sites to one or more hosts on an Ethernet LAN.
- MUXserver 300/DECmux 300 remote terminal server. Connects up to 92 Digital terminals, PCs, or serial printers at remote sites to one or more hosts on an Ethernet LAN.



- **Router Servers**

- DECrouter 200. Transfers data packets from DECnet nodes on Ethernet to remote DECnet nodes or other Ethernet LANs via asynchronous lines.
- DECrouter 2000. Provides synchronous connections to a remote DECnet system and LANs in a wide area network or between remote LANs using DECnet.

- **Gateway Servers**

- X25router 2000. This server combines the functions of the DECrouter 2000 with additional X.25 connections to Packet Switching Data Networks (can run both DECnet and X.25 concurrently).
- DECnet Router/X.25 Gateway. This server connects DECnet/Ethernet LANs to X.25 packet-switched data networks and to remote DECnet systems.
- DECnet/SNA Gateway for Synchronous Transport. Connects 802.3/Ethernet LANs to IBM hosts using high-performance and high-bandwidth connections to front-end processors.
- DECnet/SNA Gateway for Channel Transport. Connects an 802.3/Ethernet LAN to an IBM host using direct attachment to the S/370 channel.

- **Printer Servers**

- PrintServer 20. A monochromatic, high-speed laser printer that provides a shared printer resource on an Ethernet LAN to VMS client systems.

- **Server Operating Environments**

Digital's servers support VMS, ULTRIX, UNIX, and MS-DOS environments. In the VMS, ULTRIX, and MS-DOS environments, users can take advantage of VAXcluster System hardware and software. The DECwindows environment is a network based window system that presents a uniform user and application interface between operating systems. Many non-Digital workstations and PCs can also be connected to Digital servers.

Digital's PCLAN/Servers and PC networking solutions are discussed in Chapter 6.

- **Rudimentary Distributed Processing**

The most basic way to use a server is to place a node on the network whose files are accessible to applications on other nodes. This accessibility can be provided by remote logins and simple remote file copies and transfers. This type of access, however, is suitable for casual use only.

- **VAX/VMS Server Environments**

- *DECnet System Services (DSS)*

We have already described the simplest level of distributed services above. In the VAX/VMS server environment, the next level of integration is to use DECnet System Services (DSS) to link VAXstation systems with other VAXstation systems and VAXcluster Systems for resource sharing and system management across the enterprise network.

DSS products are layered on DECnet software and provide single workstations and VAXcluster Systems in both Local and Wide Area Networks (LANs and WANs) with:

- Shared resources
  - Disks, files, applications
  - Printers, plotters
  - System management personnel
- Increased network transparency

VAXcluster Systems allow the interconnection of cooperating systems into a single entity that is comparable to a single CPU in a DECnet environment. VAXcluster System members are closely coupled for intensive resource sharing.

DSS provides networkwide services that link these autonomous entities—VAXcluster Systems and standalone

systems—into an integrated network. The DSS family consists of the following products:

- Remote System Manager (RSM). Provides automated, unattended management of remote VMS and ULTRIX systems for purposes of software distribution, operating system installation and backup.
- Distributed File Service (DFS). Provides high-speed, transparent access to remote files and disks for VMS users.
- Distributed Queueing Service (DQS). Facilitates global, transparent use of remote print devices for VMS users.
- Distributed Name Service (DNS). Provides networkwide, consistent naming and addressing functionality for Digital products such as DFS and RSM and for customer-written applications.

DSS products and VAXcluster Systems provide the flexibility to address almost all distributed computing needs. All systems, whether clustered or not, for example, may need DQS to facilitate printer usage and report distribution. Only some systems, though, particularly those in VAXcluster Systems, may need DFS for accessing files outside the VAXcluster Systems. Any system can be an RSM server and can service multiple VMS and ULTRIX clients, both single workstations and NI-based (Network Interconnect) VAXcluster System boot nodes.

The DSS products use a client/server model. A server provides a service or services, but is not a single point of failure for the client system. On the other hand, the DSS products do not permit high availability and failover of computer services in case of hardware failure. And DFS does not support remote file access for multiple writers. Only one writer or many readers can access a file mounted remotely with DFS. Diskless workstations are also not supported by DSS. Each DSS client has its own version of the operating system.



## • VAXcluster System Server Environments

VAXcluster System hardware and software provide an important level of integration and availability. A VAXcluster System enables users to share all computer resources (not just files) on the cluster as if it were their own system. VAXcluster System software is included as part of the standard system software provided when you purchase a VAXserver. You can also purchase VAXcluster System hardware components and software separately to upgrade existing VAX computers.

There are three implementations of VAXcluster Systems: CI, Local Area, and mixed-interconnect.

A CI VAXcluster System uses the Computer Interconnect (CI) high-speed bus to connect large VAX processors and devices to form a single, clusterwide system.

The Local Area VAXcluster System uses the industry-standard Ethernet interconnect for clusterwide communications. This connects smaller VAX processors, such as MicroVAX and VAXstation systems, to form a single VAX/VMS system. It has many of the advantages of the CI VAXcluster System, including a single distributed system and a centralized management and security domain. The Local Area VAXcluster System is also called the NI-based (Network Interconnect) system.

The mixed-interconnect VAXcluster System uses both the Computer Interconnect and Ethernet for clusterwide communications. It connects CI and Local Area VAXcluster segments to form a single VAXcluster System in which the full range of VAX processors can participate.

The attributes of VAXcluster types are identified in Table 2-4.

**Table 2-4 • Attributes of VAXcluster Configuration Types**

<b>Configuration Attributes</b>	<b>CI-Based</b>	<b>Ethernet-Based</b>	<b>Mixed-Interconnect</b>
Central system management	Yes	Yes	Yes
Shared writes	Yes	Yes	Yes
I/O rate (Mbytes per second)	Yes	Yes	Yes
Workstations	No	Yes	Yes
Amount of data storage <sup>1</sup>	Large	Small	Large
Number of clustered spindles	160+	20+	160+
Power range of CPUs <sup>2</sup>	Medium-High	Low-High	Low-High
Availability	Highest	High	High
Redundant CPUs	Yes	Yes	Yes
Redundant disk controllers	Yes	Yes	Yes
Redundant disks	Yes	No	Yes
Include MicroVAX systems	No	Yes	Yes
Include VAX-11/7xx systems	Yes	Yes	Yes
Maximum distance between nodes	Less than 90 meter <sup>3</sup>	About 2,000 meters	About 2,000 meters

<sup>1</sup>For simultaneously shared data.

<sup>2</sup>Small = 0 to 3 VUPs, Medium = 4 to 12 VUPs, Large = greater than 12 VUPs.

<sup>3</sup>While 45 meters is the maximum length of CI cables, because cables must be run under the floor and through overhead racks, the distance between the Star Coupler and a given CPU or HSC subsystem is typically less than 45 meters.

## • VAXcluster Systems

A Local Area VAXcluster System uses industry-standard Ethernet to connect up to 41 VAXstation systems with a boot or host node. The VAXstation systems can have local disks or be diskless. Local Area VAXcluster Systems can use dual-host MicroVAX boot nodes and shared DSSI disks to provide high availability and failover. (LAVc can support UNIX workstations if the server is running the VMS/ULTRIX Connection.)

Advantages of the Local Area VAXcluster System include a single distributed file system and a centralized management and security domain.

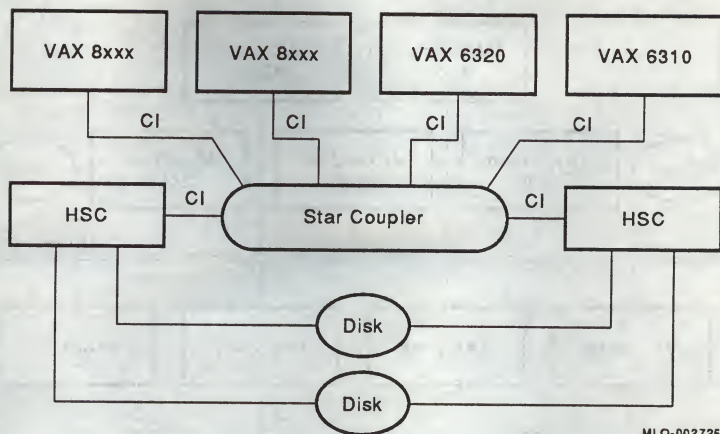
## • Computer Interconnect (CI) VAXcluster System

A CI VAXcluster System uses the Computer Interconnect (CI) high-speed, dual-path bus for clusterwide communications. It connects many large VAX processors and Digital Storage Architecture devices to form a single system. This system enhances the performance and storage capacity of any processor within the cluster and supports high availability.

A CI VAXcluster System includes up to 24 nodes with VMS Version 5.1. Because of the connection of nodes through the CI and the HSC (Hierarchical Storage Controller), automatic failover of processing nodes is possible.

Figure 2-10 shows a CI VAXcluster System.



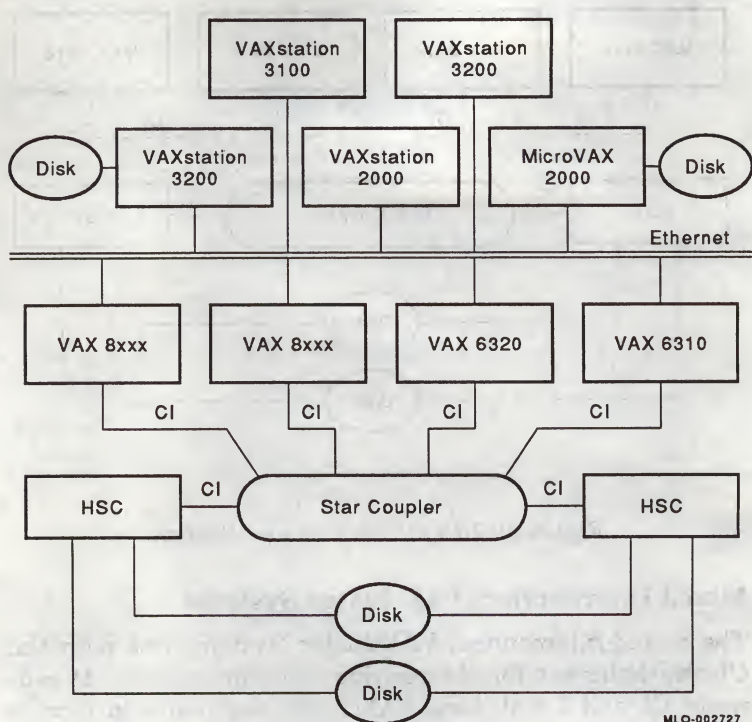


*Figure 2-10 • CI VAXcluster System*

#### • Mixed Interconnect VAXcluster Systems

The mixed-interconnect VAXcluster System uses both the CI and Ethernet for clusterwide communications. It connects CI and Local Area VAXcluster segments to form a single VAXcluster System in which the full range of VAX processors can participate.

Mixed-interconnect VAXcluster Systems are depicted in Figure 2-11.



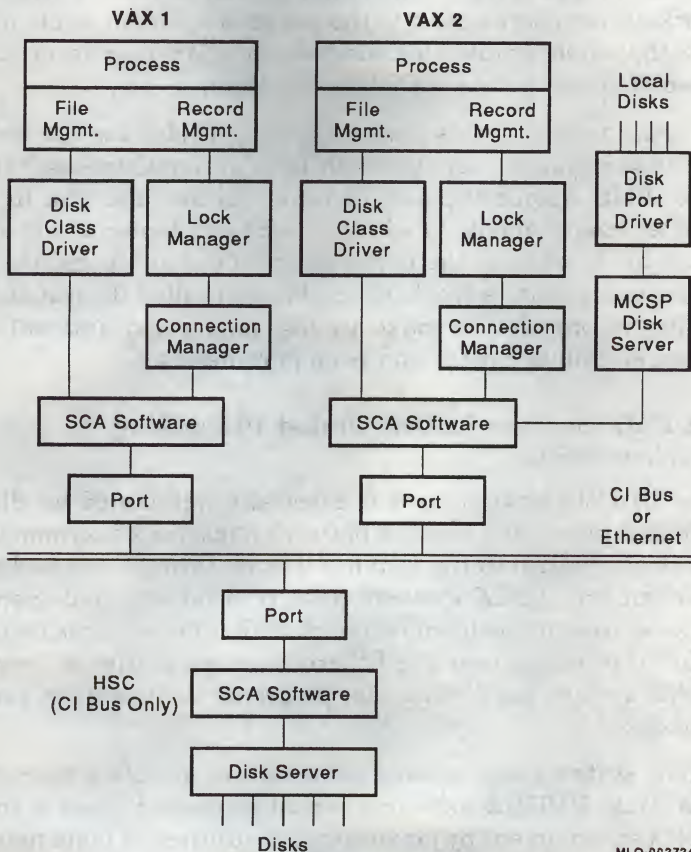
*Figure 2-11 • Mixed-interconnect VAXcluster Systems*

### • Software Components of a VAXcluster System

The VMS file system software architecture is based on the concept of clusterwide and uniform logical block access to the mass storage managed by a distributed file system. A distributed lock manager arbitrates between requests from applications performing writes and reads of files and records.

A small Local Area VAXCluster system and some of its principal software components are illustrated in Figure 2-12.

Note that the operation of the VMS software is the same for all VAXcluster System variants.



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Figure 2-12 ■ Software on Local Area VAXcluster System



- *Installing and Managing a VAXcluster System*

The design, installation, and management of any distributed computing resource is complex. However, one of the features of using a VAXcluster system is that it provides workstation users access to the power of a cluster while using the same simple DECwindows or VMS user interface used on a standalone VAXstation system.

In order to deliver this power, Digital provides the network or cluster system manager with tools designed to ease this job. VMS Accounting and Monitor utilities also run in a cluster environment. In addition, a Show Cluster utility allows you to monitor the performance of the nodes and their communications. A feedback mechanism called the Autogen utility is provided to make tuning simple and automatic. Autogen tailors cluster and node parameters.

- **ULTRIX Servers in Distributed Processing Environments**

The ULTRIX environment is especially well-suited for distributed processing because of the rich interprocess communications built into the ULTRIX kernel through the socket mechanism. UNIX systems have traditionally had many ways to communicate and do work with other systems using TCP/IP protocols over the Ethernet network. Almost every UNIX system has file transfer programs such as uucp, rcp, and ftp.

UNIX systems can be very powerful but are often hard to use. With ULTRIX software, Digital has added value to the UNIX environment by providing such utilities as Remote Installation Services. Installed on a server, this utility makes a full UNIX environment easier to install.

- *ULTRIX-32 Remote Installation Services (RIS)*

The Remote Installation Services (RIS) utility allows central registration, installation, and control of systems and user software on selected client nodes. Installed on the server, RIS contains the software subsets and the permission files for each client. The system manager selects the profile of software for each client workstation and registers them for RIS support. At installation time, RIS copies software to each client workstation according to its profile. Software updates can be performed centrally under control of RIS.

- *ULTRIX Server Support for TCP and DECnet Environments*

Like most UNIX systems, ULTRIX-32 includes TCP/UDP/IP software. Digital also supports DECnet networks with the DECnet-ULTRIX family of products. Digital servers, such as the VAXserver 6310 configured with multiple DEBNA network interfaces running the ULTRIX operating system, can also interface with several different protocol networks concurrently. For example, one network can be TCP/IP for the workgroup and another DECnet for the corporate backbone. These systems can also perform routing for the workgroup if desired.

Both TCP/IP and DECnet networks can also run over the same Ethernet controller board. In addition, with DECnet-ULTRIX on the ULTRIX node, TCP/IP hosts and DECnet nodes can communicate by mail, file transfer, and remote login through the DECnet-ULTRIX Internet Gateway.

- *The Network File System (NFS)*

Digital has added Network File System software running over TCP/IP to its ULTRIX systems. ULTRIX/NFS supports transparent sharing of file systems throughout the network. An NFS server makes its file directories available (exports them) to requesting systems (clients). The client then is-

sues a mount command to the server's NFS so the user can read and write files as though they were stored locally.

Any system with a disk can act as a client, a server, or both. A system utility called Yellow Pages (YP) acts as a central dictionary of NFS servers, clients, and file systems. Digital has added a number of utilities and enhancements to NFS to simplify its setup and maintenance.

#### ▪ *Servers That Support Diskless Workstations*

An additional feature of ULTRIX-32 operating system software is the support of diskless workstations through Diskless Management Services (DMS). The DMS utility allows diskless systems to boot from a properly configured VAXserver. The DMS utility is a menu-driven interactive utility that works with Local Area Network (LAN), Maintenance Operation Protocol (MOP), and NFS software that has already been set up on the server's disks.

DMS sets up disk partitions for the file system supporting diskless clients, configures kernels for the diskless processor types, and sets up the server defaults. The client is then registered with MOP, which provides boot and crash services on the server for the diskless client. A diskless root directory is provided for each client. DMS allows you to interactively tailor the characteristics of each client, as well as calling `nfssetup` and `ypsetup` to install default NFS and YP environments for the clients. DMS also supports paging and swapping over the network.



• *Comparing VMS VAXcluster System and ULTRIX Server Environments*

The Network File System (NFS) is part of the ULTRIX base system software and governs file sharing among networked systems. NFS is operating system independent; file sharing can occur among any systems that implement it.

NFS supports transparent file sharing through the sharing of remote file systems in an Ethernet network. A server system makes its file systems and directories available (exports them) to requesting systems (clients). Once the client system has mounted a server's file system or directory (using the mount command), its users can read and write files as though working locally. Any networked system can act as a client, a server, or both.

An NFS server in a Local Area Network with diskless clients is defined as the system with at least one local disk that provides NFS services (exports its file systems) to the other systems on the network. An area of the server's local disk contains system software that is executed by diskless clients.

NFS daemons (system processes) execute on the server and handle file requests on behalf of clients. An NFS daemon is comparable to a detached process on VMS.

The NFS client is the one that receives these services. Clients are booted from the server and use server software as if it were located locally on the client.

Table 2-5 illustrates the differences between ULTRIX/NFS and Local Area VAXcluster Systems from the client's perspective.

**Table 2-5 • Comparison of ULTRIX/NFS,  
ULTRIX/NFS Diskless, and VMS/VAXcluster**

	VMS/LAVc	ULTRIX/NFS	ULTRIX/NFS Diskless
Operating system image location	Remote	Local	Remote
Crash dump file location	Remote	Local	Remote
Page/swap file location	Remote or local	Local	Remote or local
System temporary files location	Remote or local	Remote or local	Remote or local
User files location	Remote or local	Remote or local	Remote or local
Application protocol	MSCP	NFS	NFS
Entity served	Logical block	File segment <sup>1</sup>	File segment

<sup>1</sup>A UNIX file is a byte stream of 1-n bytes. There is no notion of record or block as in VMS. The term *file segment* denotes a contiguous stream of bytes within a file that constitutes a portion of the file.

## • ULTRIX CI/HSC Based Server Environments

Applications, especially graphics, images, and engineering applications, can use many megabytes of disk space. Although mechanisms such as NFS make it unnecessary and undesirable to store multiple copies of identical files, more storage is needed, especially if you are using diskless workstations.

Using its proven cluster technology, ULTRIX-32 Version 3.0 supports up to 32 disk (or tape) devices per CI (16 per HSC), with up to 16 hosts supported per CI. This affords shared storage of up to 800 Gbytes using SA Storage Systems. The software uses a network driver to handle host communications through the CI as well as through the network. Communications between hosts on the CI and on the network can occur either through the Ethernet or through the CI. The software uses block mode of the HSC and thus is a good medium for offloading network traffic. Directories





vironments. Many of the communications discussed in this chapter enable these connections.

Chapter 4 describes how the DECwindows interface provides a common environment across different operating systems. VAXserver and DECsystem 3100 systems running ULTRIX support both VAXstation and RISC DECstation systems running ULTRIX.

- *Support for Multivendor UNIX/NFS Workstations*

The VAX Fileserver 6310 and 6320 make it possible to connect large workgroups of UNIX workstations from different vendors. Large files can be stored on the disks of the 6310 and shared between NFS client workstations. In many cases even diskless workstations from other vendors can be supported. Contact your Digital representative for more information about your specific application.

- **VMS/ULTRIX Connection**

The ULTRIX/VMS Connection provides NFS server and TCP/IP Ethernet support to VMS servers. Under control of the server, users of ULTRIX, UNIX, and VMS systems can store and share files. The files can appear as native to the user's operating system and local to their workstation. You can store the files on the server as VMS files, UNIX files, or as files under control of RMS. Programs making RPC calls use standard NFS XDR protocols to access the files. ULTRIX/VMS Connection software performs efficient translation of file names to those expected by the requesting operating system. Using the Connection, you can store files in a Local Area VAXcluster System or mixed-interconnect VAXcluster System, with all the benefits of volume shadowing, processor redundancy, and large disk farms of up to 800 Gbytes.

If you are using UNIX systems other than ULTRIX software, your Digital representative can tell you how to use your system with the VMS/ULTRIX Connection to gain access to services and functions provided by your Digital servers.

### ▪ **Choosing a Server for a Workstation Environment**

As you have read, there are many types of distributed environments in which the workstation-server model is implemented. Perhaps the best way to choose the sort of server you need is to begin at the workgroup or application level and try to classify your system. Your Digital representative can help with your analysis.

There are no simple rules. Rather, a server is a complex system with many variables. However, characterization studies conducted by Digital have found that the primary factor in file server performance is the speed and capacity of the I/O subsystem. In many cases adding an additional high-performance disk such as the RA90 improves server performance more than adding a faster processor. Also the Ethernet interface is not a constraint until the disk subsystem becomes fully utilized.

### ▪ *Questions to Ask When Choosing a Server*

- How many workstations do you want to serve?

There are practical, cost, and licensing limits.

- What type of application do you have?

Most workstation-based applications can be supported by servers, but some emphasize I/O speed and storage, while others demand CPU power on the server.

- Do you want a single or multifunction server?

Using RA disks, even a VAX-11/780 can make a cost effective Local Area VAXcluster System boot server for a small number of workstations. However, if asked to perform other functions, such as timesharing, its utility diminishes.

- Do you have a single or multivendor environment?
- What are your storage requirements?

Access to large databases (over 25 Gbytes) makes either the mixed-interconnect VAXcluster System or the ULTRIX/CI environment an attractive choice.

- Do you need a high-availability system?

A dual-host VAXserver in a Local Area VAXcluster System, a mixed-interconnect VAXcluster System, or an ULTRIX/CI or Connection-based server can meet this need.

- What type of response time do your users want?

Under certain circumstances, running applications on a workstation in a mixed-interconnect VAXcluster System can provide users with better response than on a standalone workstation. However, there is a trade-off between the number of workstations supported, the total power of the server, the application, and the response time.

Work with your Digital representative to characterize your workstation environment.

### ▪ **Positioning of VMS/Local Area VAXcluster System Disk Servers by Performance**

Table 2-6 shows the relative performance of five Digital systems in a VMS/LAVc disk server environment. Factors that can cause performance to vary significantly in a user's environment are:

- The specific application running
- Amount of remote disk I/O generated by the application
- Balance of the I/O load to the available disk
- Condition in which the server provides only remote disk services



Compare the percentage of CPU idle for the servers in Table 2-6. The disk server configurations compared are not necessarily configured to achieve their maximum performance potential. This additional CPU capacity could provide the opportunity for additional application activity, the support of more workstation loads, and additional disks. Use this matrix to assess the performance of different servers and the possibilities for these servers in varying application environments.

**Table 2-6 • VMS/Local Area  
VAXcluster Disk Server Performance**

<b>Server</b>	<b>CPU % Idle</b>	<b>Disks 1/sys 3/user</b>	<b>Number of w/s loads</b>	<b>Ethernet % busy</b>
MicroVAX II	57%	RA81	12	<20%
MicroVAX 3600	63%	RA82	17	<20%
MicroVAX 3900	75%	RA90	17	<20%
VAX 6310	77%	RA82	17	<20%
VAX 8550	87%	RA82	17	<20%

**Assumptions**

1. Zero think time
2. Constant load
3. VMS environment only
4. Each workstation load produces a load to the disk server of from 1.8 to 2.2 I/O requests per second.
5. MicroVAX 3600 and 3900 are installed with Autogen, with feedback enabled.

## ▪ Applications

The performance of any application is heavily dependent on the computer system. In the following discussion, four key workstation hardware performance attributes are examined to accurately gauge system performance. These attributes are:

- General-purpose CPU performance
- Floating point performance
- Graphics performance
- Input/Output (I/O) performance

## ▪ General-Purpose CPU Performance

General-purpose CPU performance is measured by the time it takes to execute instructions that:

- Move data from one memory location to another
- Compare two numbers
- Branch, jump, and return to a program subroutine
- Add and subtract integers

These instructions are processed by the general-purpose CPU employed by the individual workstation.

System performance can be measured by using various benchmark programs such as Dhrystone, Khornerstone, and Whetstone. A benchmark is a collection of programs meant to test various components of a system, such as arithmetic, I/O, or graphic speed. There is no industry-standard benchmark, so benchmarks can vary from manufacturer to manufacturer.

## ▪ Floating Point Performance

Floating point performance is measured by the time it takes to execute instructions that operate on floating point numbers. Typically required only by applications that process floating point, computations are performed by a special processor known as the floating point unit (FPU), which is

optional on some systems and standard on others. The floating point unit can be a single chip or a costly plug-in module with a number of highly specialized components that work together to perform floating point operations.

Floating point performance is measured in megaflops (millions of floating point operations per second). Linpack is a benchmark that measures floating point performance.

## • Graphics Performance

Graphics performance is measured by the amount of time required by the system to perform graphics operations such as drawing a line on the screen, filling in a circle, writing text, or copying portions of the screen from one region to another.

The system can execute graphics in two basic ways:

- The general-purpose CPU and floating point unit share the task of executing graphics operations.

When this method is used, the general-purpose CPU and the floating point unit can perform graphics algorithms or execute other aspects of an application, but cannot perform both types of tasks at the same time. The result is markedly slower system performance.

- A special graphics processor is dedicated to graphics operations. This processor operates in parallel with the general-purpose CPU and the floating point unit.

In such a system, the performance of the graphics processor has minimal impact on the performance of the general-purpose CPU or the floating point unit.

To date, because of the diversity of graphics systems in use, there are no widely agreed upon graphics performance benchmarks.



## ▪ Input/Output (I/O) Performance

I/O performance is measured by the amount of time it takes to move information into, out of, or within a computing system. I/O is often the most difficult metric to measure because it is highly dependent upon the interaction of every component of the system: general-purpose CPU, floating point unit, memory system, bus, disks, graphics, and network.

For example, a poorly engineered memory system slows down the system because the general-purpose CPU cannot get the instructions and data it needs to execute. Similarly, even the fastest CPU can be bogged down by an outdated disk subsystem design.

Like graphics performance, I/O performance is difficult to measure and compare, and there is no agreed-upon metric for its measurement.

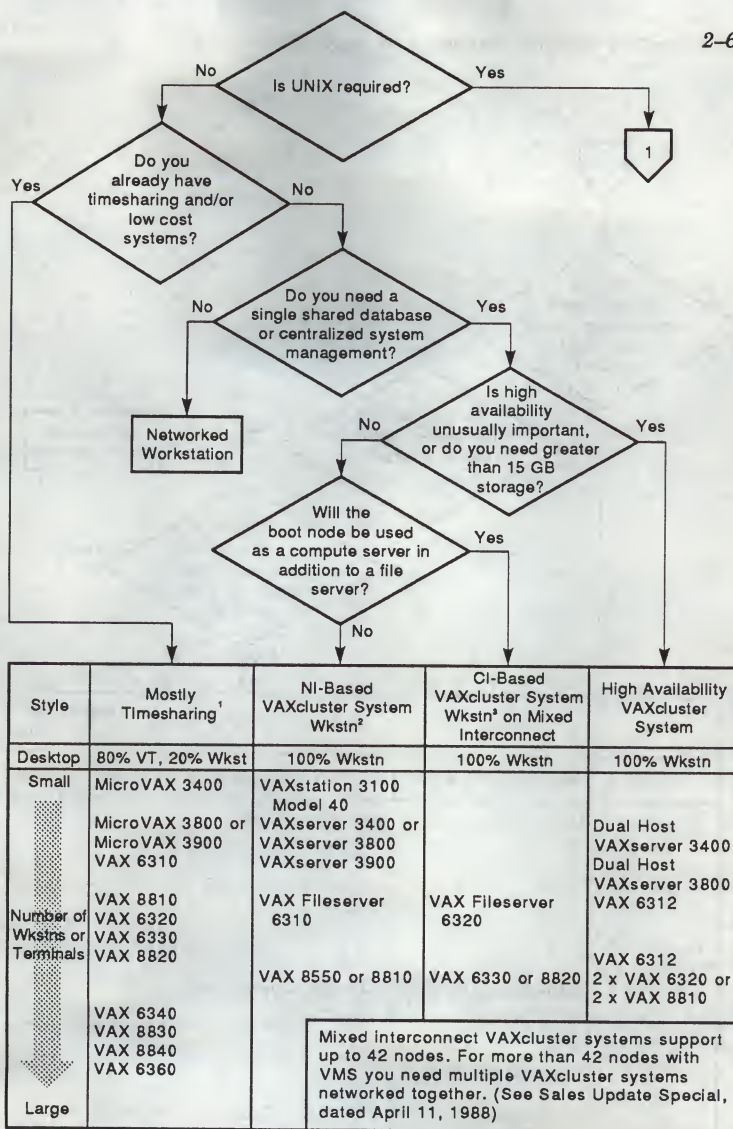
## ▪ Product Selection Charts

The following three charts illustrate the key selection criteria in obtaining the correct mix of Digital system and VAXcluster products. The charts should be used only as guidelines. Computing requirements vary and Digital workstations and server products address a wide range of computing needs.

## ▪ Professional Engineer

Figure 2-14 shows a flow chart for a professional engineer using VMS. Figure 2-15 shows a flow chart for a professional engineer using UNIX.

- *Typical Users:* Automotive designer, circuit designer, graphics designer, R & D research (chemist), typesetter
- *Typical Applications:* Develop complex products/processes, often with high design, visual and/or logic content. Sophisticated graphics orientation.



<sup>1</sup> Based on the Electronic Computer Aided Engineers workload. See VAX Performance Summary--The VAX 6300 Series (EJ-32878-46) for details.

<sup>2</sup> Boot node is a file server.

<sup>3</sup> Boot node is a file server and compute server.

Figure 2-14 • Professional Engineer: VMS

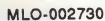


Figure 2-15 ■ Professional Engineer: UNIX



▪ *Assumptions Used in Professional Engineer Product Selection Chart*

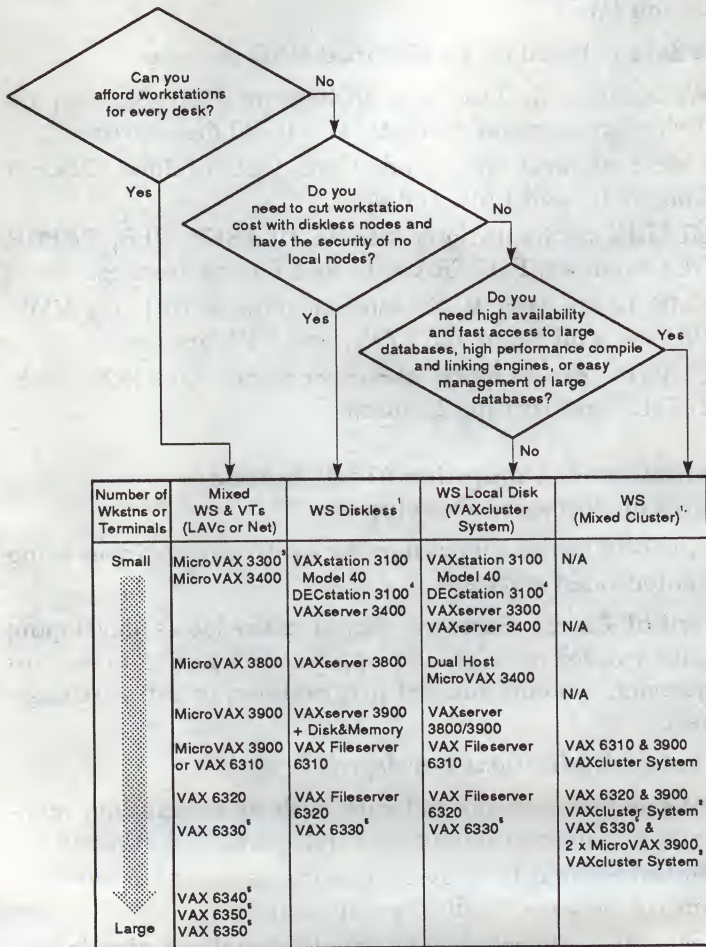
The data is based on an electrical CAD designer:

- Workstation desktop is a VAXstation 3100, 8-plane, 19-inch color monitor, 8 Mbyte, two-RZ23 disk system.
- VMS configurations include VMS, DECwindows, DECnet End Node, and LAVc software.
- ULTRIX configurations include ULTRIX, NFS, TCP/IP, DECwindows, FORTRAN, C, and Pascal licenses.
- VMS Local Area VAXcluster boot node includes VMS, DECnet Full Function, LAVc, and VPA licenses.
- ULTRIX file/compute server includes ULTRIX, NFS, TCP/IP, and DECnet licenses.

▪ **Professional: Computer-Aided Software Engineer/Software Developer**

Figure 2-16 shows a flow chart for a software engineer using computer-aided software.

- *Typical Users:* Someone whose main job is developing software, for example, an applications programmer, microcoder, systems support programmer, or software engineer.
- *Typical Applications Developed:*
  - Information systems software such as accounting, management information and control, personnel systems.
  - Embedded/real-time systems such as avionics, robotics, control systems, medical equipment.
  - Technical software such as scientific analysis, simulation, CAD and CAE software.

<sup>1</sup> Reference to VAXcluster System can be substituted with NFS for ULTRIX environments.<sup>2</sup> Mixed interconnect VAXcluster systems support up to 42 nodes. For more than 42 nodes with VMS, you need multiple VAXcluster systems networked together.<sup>3</sup> The difference between the MicroVAX 3300/3400 systems is storage capacity and slot availability.<sup>4</sup> This system runs ULTRIX only (See footnote <sup>1</sup> above).<sup>5</sup> VAX 6330, 6340, 6350, and 6360 systems are not supported under ULTRIX.

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**Figure 2-16 • Computer-Aided  
Software Engineer / Software Developer**

### ▪ *Applicable CASE Tools*

The process of developing software is similar whether you are developing commercial business applications or technical engineering systems. The differences between these groups is usually reflected in the selection of programming language(s) and/or software development tools. The following list indicates the software that could be used to assist in software development. Software that would primarily be used by a commercial or technical organization is noted.

### ▪ *All*

- Analysis/Design Tools
- CMP/CSO<sup>1</sup>
  - Excelerator—Index Tech.
  - DesignAid—Nastec
  - Teamwork—Cadre
  - Software through Pictures—IDE
- VAX Software Project Manager<sup>1</sup>
- VAXset
- VAX Notes
- VAX DOCUMENT
- ULTRIX Programming Utilities

### ▪ *Information Systems*

- VAX COBOL GENERATOR
- VAX RALLY
- Rdb/VMS with SQL
- VAX CDD/Plus

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<sup>1</sup> Analysis/design tools utilize workstation-based graphics.



- ***Embedded/Technical***

- Modeling/Simulation
  - ADAS—Research Triangle Inc.
  - Satemate—Logix
  - Microprocessor SW
- Development Tools
  - BSO Tools—Boston Systems Office
  - LANDS—Tektronix, MDP Div.

- **Positioning of Workstations by Performance**

The DECstation 3100 far exceeds other workstations in performance, as shown by industry-standard benchmarks.

Figure 2-17 provides relative positioning of the DECstation 3100 and VAXstation systems using three benchmarks: Dhrystone, Whetstone, and Linpack. While a specific application benchmark provides better overall system performance and productivity data, these benchmarks are accepted as starting points for basic performance characterization.

Dhrystone indicates CPU performance when the CPU manipulates integer data. Whetstone and Linpack indicate floating point performance. The Whetstone benchmark is most representative of small engineering/scientific applications that can fit into cache memory. The Linpack benchmark, measured in megaflops (Mflops), gauges engineering/applications such as finite element, finite difference, simulation and regression analysis.

Workstations <sup>1</sup>	Dhrystone <sup>2</sup>		Whetstone			Linpack				
	Metric Kdips STD	Relative Perform- ance x780	Metric Kwips SP	Relative Perform- ance x780	DP	Relative Perform- ance x780	DP	Relative Perform- ance x780	DP (BLAS)	Relative Perform- ance x780
DECstation 3100	25,000	14.00	11,455	8.80	8,924	11.50	3.70	14.80	1.60	11.80
VAXstation II	1,750	.98	954	.74	667	.86	.121	.48	.167	
VAXstation 3520 <sup>3</sup>	5,416	3.00	3,557	2.70	2,363	3.00	.73	2.90	.39	
VAX-11/780	1,782	1.00	1,295	1.00	775	1.00	.25	1.00	.14	1.00
VAXstation 3200/3500	4,816	2.70	2,994	2.30	1,898	2.40	.66	2.60	.41	2.60

<sup>1</sup> The VAX-11/780 is used as a relative performance comparison to the workstations' performance data.

<sup>2</sup> Assume VAXstation 3520 only, not 3540.

<sup>3</sup> Assume Dhrystone V1.0.

MLO-002715

Figure 2-17 ■ Workstation Performance





## **Chapter 3 • Standards**

### **• The Importance of Standards**

This chapter provides an overview of workstation-related industry standards. As a customer, you protect your investment by purchasing products that adhere to accepted industry standards. The X Window System standard and the Open Software Foundation, an organization designed to promote a portable software environment based on UNIX, are also discussed.

Standards define common approaches, protocols, and interfaces that encourage compatibility and consistency among computer manufacturers. The main benefit to you, the customer, is application portability and investment protection.

Digital understands the productivity advantages available by using standard interfaces, protocols, and languages to manage information. Digital contributes to the development of standards with representatives on over 150 technical standards committees worldwide.

Digital has a widely recognized leadership position in developing standards policies and procedures, and offers a broad variety of products based on standards. Digital is committed to having its products, VMS and ULTRIX, meet all information interchange standards.

Some of the organizations that evaluate, adopt, and promote standards in the computer industry are the American National Standards Institute (ANSI), the International Organization for Standardization (ISO), the Institute of Electrical and Electronic Engineers (IEEE), and the Consultative Committee for International Telephone and Telegraph (CCITT). In addition, the Open Software Foundation (OSF) is a nonprofit research and development corporation committed to global acceptance of a single standard for open software.

By participating in standards-related activities, Digital demonstrates a commitment to design implementations that are in the best interests of its customers. Digital, as well as other companies who adhere to industry standards, is building system compatibility and application portability into its products.

### ■ Workstation-Related Standards

Many important workstation-related standards and de facto standards are summarized in Table 3-1. De facto standards are implementations that are widely used but have not been officially adopted by a standards organization.

**Table 3-1 • Workstation-Related Standards**

Standard	Description
<b>Operating Systems</b>	
VMS	VMS is Digital's proprietary operating system used on all VAX processors. In use since 1978, VMS has served as the base for extensive application development in many industry areas.
UNIX	UNIX is the operating system developed at Bell Laboratories and subsequently implemented on the machines of many computer manufacturers. The operating system is taught and used in major universities throughout the world.
<b>Networks</b>	
DNA	The Digital Network Architecture is Digital's proprietary networking architecture that allows communication between all Digital systems and the systems of many other manufacturers. DNA conforms to the ISO seven-layer model.
NFS	The Network File System, developed by Sun Microsystems, Inc., and adopted by over 30 computer manufacturers, governs file sharing and administration among computer systems on a network.
MAP	The Manufacturing Automation Protocol specification, initiated by General Motors, governs multivendor networking in a factory environment. MAP conforms to the ISO seven-layer model.
TOP	The Technical and Office Protocols comprise a set of standards used for information exchange in a vendor technical and office network. TOP conforms to the ISO seven-layer model.
TCP/IP	Transmission Control Protocol/Internet Protocol is a set of software communications protocols, developed originally at Berkeley and used extensively in UNIX operating environments. TCP/IP conforms to the lower four layers of the ISO seven-layer model.



**Table 3-1 (Cont'd.) • Workstation-Related Standards**

Standard	Description
<b>Networks</b>	
DECnet/OSI	ISO 7498 is a reference model for Open System Interconnection (OSI). The model divides networking functions into seven layers with identified functions in each layer. The model thus provides an architectural basis for existing and proposed OSI standards.
X.400	X.400 comprises a set of standards approved by CCITT that specifies how networks exchange electronic messages among private mail systems and/or public communications carriers.
X.25	X.25 is a standard recommended by CCITT that defines a computer's interface with packet-switched data networks.
IEEE 1003.1	An IEEE standard for an operating system interface, also known as POSIX (Portable Operating System Interface for Computer Environments).
IEEE 802.3	IEEE Standard 802.3 defines how Local Area Networks use CSMA/CD (Carrier Sense Multiple Access with Collision Detection) techniques in accessing a baseband or broadband Ethernet channel.
<b>Window Systems</b>	
X	<p>The X Window System, developed at MIT, is a device-independent, network-based programming interface that has been adopted by many major computer manufacturers. ANSI has an approved project to make the X Window System a standard.</p> <p>The X Window System provides capabilities for managing windows over networks and provides graphical and text output through a window.</p>
MS-Windows	MS-Windows, developed by MicroSoft Corporation, provides an intuitive and versatile user interface for MS-DOS applications.
PEX	PHIGS Extensions to X supports 3D graphics via PHIGS within the X Window environment. It was developed by the MIT Consortium.

**Table 3-1 (Cont'd.) • Workstation-Related Standards**

Standard	Description
<b>Graphics</b>	
PHIGS	<p>Programmer's Hierarchical Interactive Graphics Standard is a graphics application interface developed by the American National Standards Committee for Computer Graphics. It is now a draft international standard.</p> <p>PHIGS defines a sophisticated three-dimensional graphics support system used to control the definition, modification, and display of hierarchical graphics data.</p>
PHIGS+	<p>PHIGS+ was developed as an extension of PHIGS to cover lighting and shading models. It is currently an ISO draft standard.</p>
GKS	<p>The Graphical Kernel System is a device-independent graphics interface that has been adopted as a standard by ANSI and ISO.</p> <p>GKS is a set of device-independent graphical input and output functions used to produce 2D images on vector- or raster-based output devices. Its functions can be used to draw lines, markers, text, polygons, or graphical input. GKS can be used to develop graphics applications for use on a variety of workstations.</p>
GKS-3D	<p>GKS-3D is a completely compatible extension to GKS that includes 3D capabilities. This is an ISO international standard.</p>
CGM	<p>The Computer Graphics Metafile is an ISO international standard file format for capturing graphics. It allows applications to store and transport pictures between applications in a device-independent manner.</p>

**Table 3-1 (Cont'd.) • Workstation-Related Standards**

Standard	Description
<b>Compound Documents</b>	
ODA	Office Documentation Architecture. An ISO standard that has content architecture for text, graphics, and images.
CDA	Compound Document Architecture is Digital's enhanced version of ODA. It allows for the combination of text, graphics, and images.
SGML	Standard Generic Markup Language. This is an ISO standard.
SDML	Standard Digital Markup Language is Digital's enhanced version of SGML. SDML conforms to the ISO standard.
PostScript	PostScript is a page description language developed by Adobe Systems, Inc. It is a de facto standard.
Display PostScript	Display PostScript, developed by Adobe, is a special version of Postscript ideally suited for display on raster systems such as workstations. It is a de facto standard.
SPDL	Standard Page Description Language is a developing ISO standard. It will combine features of Adobe's PostScript and Xerox Corporation's Interpress page description languages.



## ▪ The X Window System

The X Window System was developed at the Massachusetts Institute of Technology to meet the needs of two groups: Project Athena, which was trying to make a network of graphics workstations useful, and a second group, which was developing distributed applications.

To meet these requirements, MIT created a windowing system architecture that allows the execution of applications to be independent of their display. Specific components of the architecture control the display of applications: other components determine how applications run.

The X Window System has become an industry standard. Digital incorporated and expanded the X Window System for the DECwindows system. DECwindows offers customers a consistent user interface across applications, different vendors' hardware, and different operating systems. DECwindows is discussed in detail in Chapter 4.

## ▪ Open Software Foundation (OSF)

The Open Software Foundation (OSF) is an international organization formed to define, develop, and make available an open, portable software environment based on the UNIX operating system. The foundation was created in May 1988, by seven major computer companies—Apollo, Groupe Bull, Digital, Hewlett-Packard, IBM, Nixdorf, and Siemens.

OSF will make it easier for customers to:

- Use application software on computers from different vendors
- Use the same application software on different classes of computers, from personal computers to supercomputers
- Have computers from different vendors use common communications standards

Recently, the industry has focused on the need for open systems, specifically the UNIX operating system. Users discovered there were over 250 different variations of UNIX, variations that were neither compatible nor adhered to an industry standard. The OSF was created to define specifications, develop leadership software, and make available an open portable software environment.

In December 1988, the OSF announced the selection of its graphical user interface, OSF/Motif, which is a composite of technologies and products from Digital, Hewlett-Packard, and Microsoft.

Motif's underlying technology is Digital's X User Interface (XUI). Microsoft's Presentation Manager was selected for the screen behavior component, and OSF chose Hewlett-Packard's 3D appearance.

XUI is considered the most advanced implementation of the X Window System in the market. Digital has made its toolkit available for almost two years and has trained hundreds of software developers.

OSF will provide the source code and a complete documentation set for OSF/Motif. Currently, more than 76 vendors from 12 countries are members of this nonprofit research and development corporation. Funding through 1991 is in excess of \$121 million. Digital supports the Open Software Foundation and its open decision-making process. Today, Digital's ULTRIX environment is OSF Level 0 compliant.

## Chapter 4 • DECwindows

This chapter describes *DECwindows*, Digital's graphical user interface that lets you use software based on the VMS, ULTRIX, and MS-DOS operating systems—at the same time and in the same way.

Regardless of the application, DECwindows provides you with a common way to access all applications.

DECwindows software cuts the tie to a specific operating system, a particular piece of hardware, or a single set of software and lets you pick the best hardware and software for your task. DECwindows lets you concentrate on your job rather than on the mechanics of doing your job.

In addition to defining a common look and feel for users, DECwindows software leads the industry in incorporating open standards for complete integration of distributed systems. DECwindows is included with VMS Version 5.1 and UWS Version 2.0 at no charge.

### • DECwindows Highlights

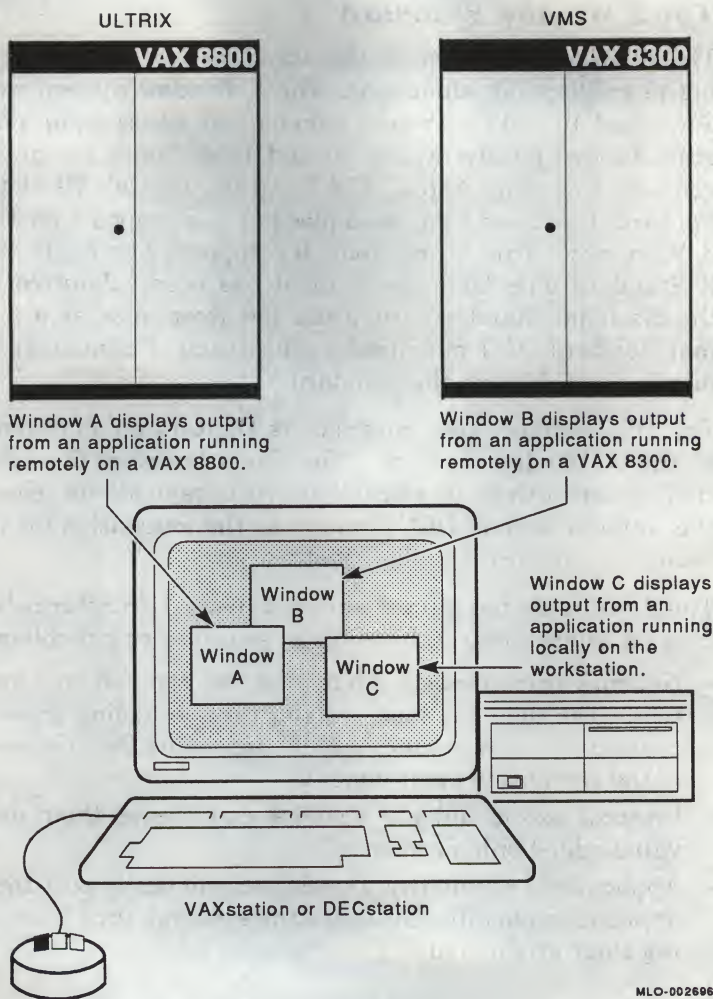
The DECwindows interface extends and improves the X Window System, Version 11, with the following features:

- Network-transparent application interface  
You can run an application on a remote node, yet the application appears to run on your workstation.
- Compatibility  
Because VMS and ULTRIX DECwindows use the same set of programming libraries, you can port applications between operating systems with little or no modifications.



- Consistent user interfaces  
All DECwindows applications support a common look and feel, regardless of the application. This makes learning new applications easier and faster.
- Graphics-oriented interaction with the operating system  
Instead of having to remember and type long commands, you use a mouse and menus with graphics.
- Documentation in two formats  
One format is tailored for end users; a second format is tailored for DECwindows software developers.

Figure 4-1 is a diagram of a typical DECwindows screen display. Three applications are displayed in windows on a workstation. Two of the applications run on remote processors, yet all three applications appear to run locally.



*Figure 4-1 ■ The Transparent Network*

## ▪ The X Window Standard

The *X Window System* is the standard for the underlying technology for windowing. The X Window System was developed by MIT's Project Athena, an educational program funded jointly by Digital and IBM. Major computer vendors, including Apple, AT&T, Apollo, Digital, Hewlett-Packard, IBM, and Sun, have pledged their support for the X Standard. This strong industry support has made the X Standard a de facto standard; it has been submitted to the National Standards Institute for acceptance as a formal standard. MIT mobilized a consortium of companies to monitor and develop the standard.

The DECwindows user interface is Digital's enhancement of the X Window System. The Open Software Foundation, a consortium of more than 70 organizations, chose the software core of DECwindows as the foundation for its industry-standard interface, Motif.

The X Standard has gained almost universal acceptance because it solves three of the industry's most vexing problems:

- Network transparency. An application can run on a system other than the host system, thus providing greater connectivity and productivity by improving the efficiency of the computing environment.
- Protocol extensibility. Vendors can create their own value-added enhancements.
- Applications portability. Developers can easily port their applications to different operating systems, thus increasing their productivity.



## ▪ Desktop Environment

The *DECwindows Desktop Environment* is Digital's software architecture that spans operating systems and hardware. This architecture lets customers write applications once, then use them on any system, anywhere in the enterprise.

The DECwindows desktop environment has two primary parts: the DECwindows user environment and the DECwindows programming environment. Both environments are discussed in the following sections.

## ▪ DECwindows User Environment

The DECwindows user environment was created to increase productivity. Because all DECwindows application interfaces look the same and operate similarly, users need learn only a single interface.

In addition to saving time in training, DECwindows software saves you time by allowing you to perform several tasks simultaneously. Using several windows on your screen, you could run a program, read mail, and execute a command procedure at the same time.

VMS users particularly appreciate using the Bookreader to read online documentation. Questions are answered in seconds on your workstation screen. You need not hunt for manuals, look up index entries, or thumb through pages of text.

Experienced users can use *accelerators*, shortcuts that let you interact with applications more quickly. *Keyboard accelerators* associate keyboard keys to menu functions; so, for example, you might press Alt/C to copy text instead of selecting COPY from a menu.

The DECwindows user environment is shown in Figure 4-2. These components are described in the next sections:

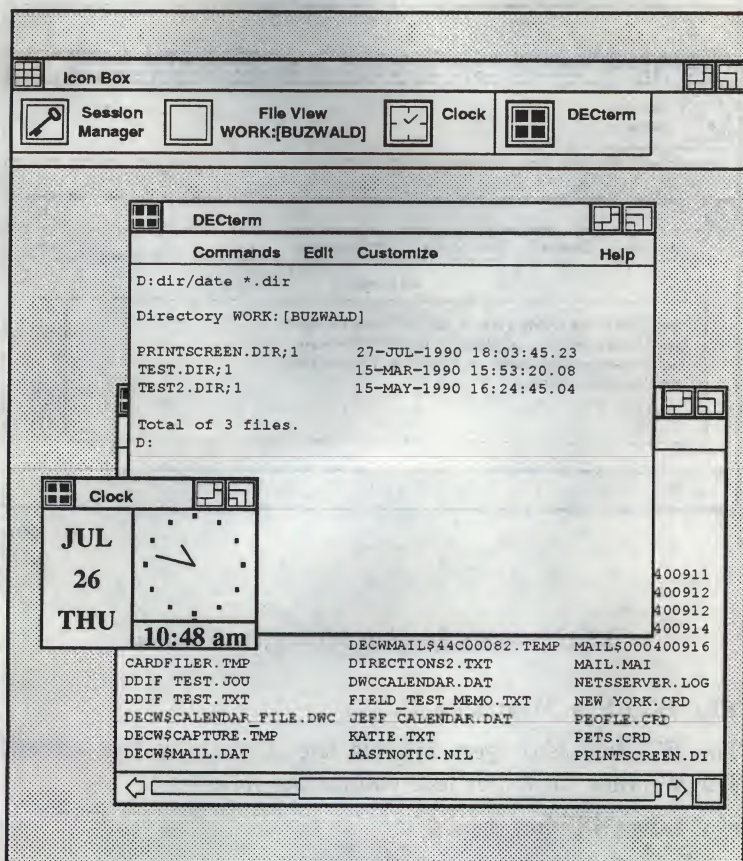
- The Session Manager
- The Window Manager
- The User Executive
- Desktop applications
- Online help

#### ▪ The Session Manager

The first step in using the DECwindows interface is to establish a session. The *Session Manager* controls and coordinates these sessions. Specifically, the Session Manager:

- Creates new sessions
- Starts the Window Manager and User Executive
- Accesses the operating system
- Prints display screens
- Customizes the user environment
- Ends sessions

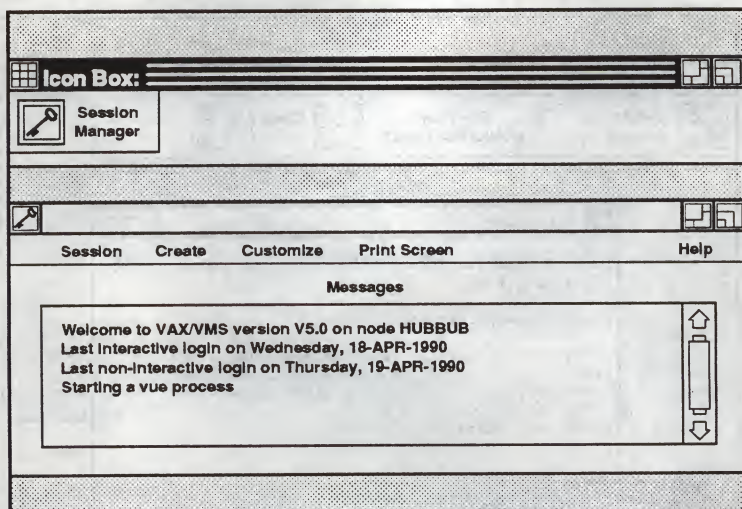
With the Session Manager you can create multiple windows and customize sessions. You can, for example, instruct the Session Manager to run DECterm, a terminal emulator that displays a window that functions like a VT320 terminal, each time a session begins. Figure 4-3 shows a Session Manager window.



MLO-002697

Figure 4-2 • DECwindows User Environment





MLO-002698

*Figure 4-3 • Session Manager Window*

### ▪ The Window Manager

The *Window Manager* controls the display on the screen. The Window Manager lets you do the following:

- Change window size
- Move windows
- Stack windows

You can also use the Window Manager to shrink windows to icons. Windows you shrink remain active; you redisplay the windows by using the mouse to click on the icon.

## ▪ The User Executive for ULTRIX and VMS

### ▪ *The ULTRIX User Executive (UE)*

The *ULTRIX User Executive (UE)* is the graphical interface to the ULTRIX operating system. UE lets you execute ULTRIX commands by selecting from menus and lets you run DECwindows applications.

The UE window displays the names of the files in your current directory and the following commands:

```
create directory
copy
display
move
search
remove
```

To execute a command, you select the appropriate file, then choose the command. UE prompts you for the parameters, then executes the command. You can customize UE. You can, for example, add commands to the list provided.

### ▪ *The VMS User Executive (VUE)*

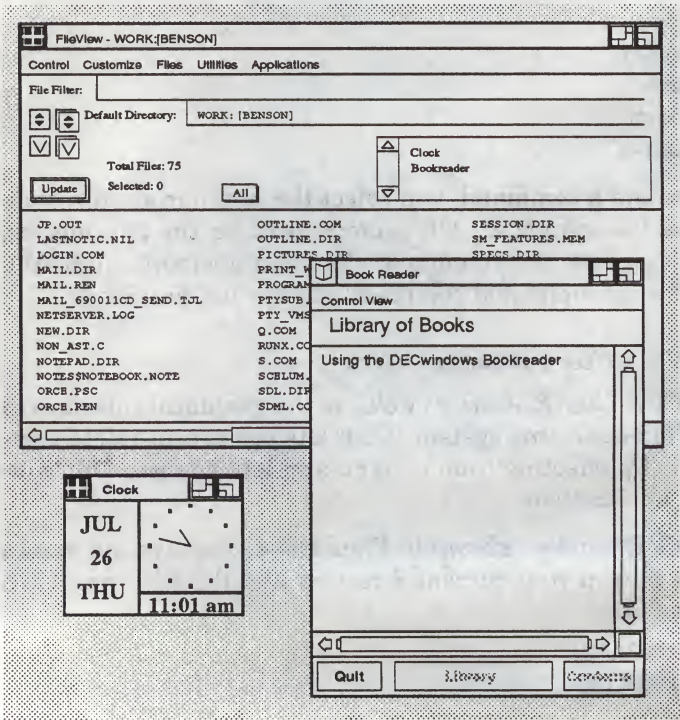
The *VMS User Executive (VUE)* is the graphical interface to the VMS operating system. VUE lets you execute VMS commands by selecting from a menu and lets you run DECwindows applications.

The VUE window, shown in Figure 4-4, displays the names of the files in your current directory and the following VMS commands:

```
COMPARE
COMPILE
COPY
DELETE
PRINT
PURGE
RENAME
```

RUN  
SEARCH  
SHOW  
TYPE

To execute a command, you select the appropriate file, then choose the command. VUE prompts you for the parameters and then performs the command. You can also customize VUE. You can, for example, add commands to the list provided.



MLO-002699

Figure 4-4 • VUE Window



## ▪ Desktop Applications

DECwindows software includes several applications designed to increase productivity by automating basic office tasks. Bookreader, for example, lets you read documentation on your workstation screen; Mail lets you send and receive electronic mail.

Because the DECwindows interface is based on the industry standard X Window System, customers can choose applications from Digital and other vendors.

The DECwindows applications are:

- Bookreader (VMS only)
- Calculator
- Calendar
- Cardfiler
- Clock
- CDA Viewer
- DECterm
- Extensible VAX Editor (EVE) (VMS only)
- Mail
- Notepad Editor
- Paint
- PostScript Viewer (ULTRIX only)
- Puzzle Game

## ▪ *Bookreader*

The *Bookreader* allows you to read online documentation on your workstation screen. You use the table of contents or the index as the navigational tool through the books. When you select an index entry, for example, Bookreader displays the text, figure, or table relating to that entry. The Bookreader is available on VMS only.

- *Calculator*

The *Calculator* performs simple arithmetic functions: addition, subtraction, multiplication, division, percentages, and square roots. The *Calculator* has two displays: one display shows the current operation; the other display shows the contents of memory.

- *Calendar*

The *Calendar* helps you plan work and schedule appointments. You can create one calendar for personal planning and another calendar for your work group. With *Calendar* you can:

- Display a day, week, month, or year
- Set reminders or ticklers
- Create and maintain multiple calendars
- Customize calendars

Figure 4-5 shows a sample *Calendar* screen display.

**CALENDAR:WORK[JONES]ANNA\_KLEIN\_CAL.DWC**

**File Edit View Schedule Options Help**

April, 1990

Wk	Sun	Mon	Tue	Wed	Thu	Fri	Sat
19	1	2	3	4	5	6	7
20	8	9	10	11	12	13	14
21	15	16	17	18	19	20	21
22	22	23	24	25	26	27	28
23	29	30					

May, 1990

Wk	Sun	Mon	Tue	Wed	Thu	Fri	Sat
14			1	2	3	4	5
15	6	7	8	9	10	11	12
16	13	14	15	16	17	18	19
17	20	21	22	23	24	25	26
18	27	28	29	30	31		

◀

▶

Thursday the 19th of April, 1990

8:00 am	
8:30	Breakfast meeting with accountants
9:00	
-30-	
10:00	
-30-	
11:00	Leave for Heathrow - 12:05 flight
-30-	
12:00 pm	
-30-	
1:00	
-30-	
2:00	
-30-	
3:00	Meet with Mirielle, Rue Ste. Germaine: bring receipts.
4:30	
5:00	
-30-	

↑

↓

Previous Day

2:21pm

Next Day

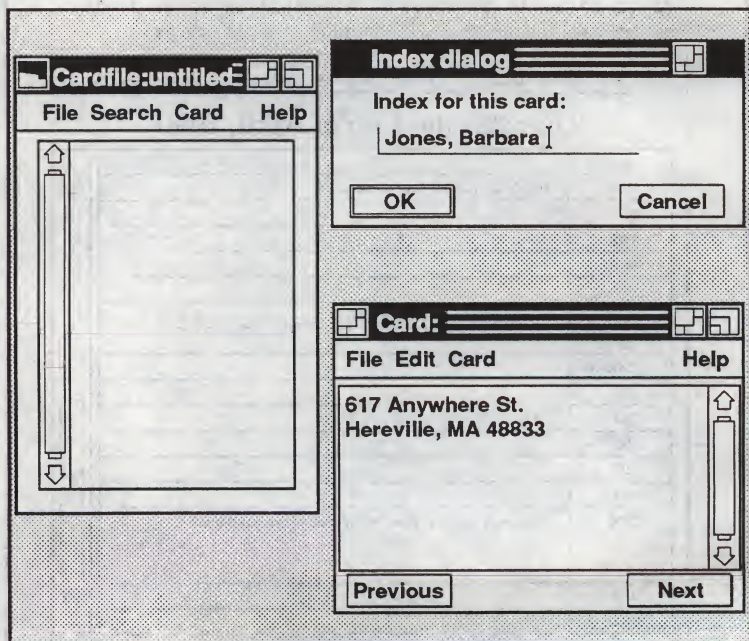
MLO-002700

Figure 4-5 • Calendar Window



### • Cardfiler

The *Cardfiler* is a system for organizing information similar to using index cards. The cards can hold any information you desire, for example, names, addresses, and telephone numbers. You can also search the card file for any text. Figure 4-6 shows a Cardfiler screen display.



MLO-002701

Figure 4-6 • Cardfiler Window

- *Clock*

The *Clock* displays the time and date. It also has an alarm you can set to remind you of appointments.

- *DECterm*

*DECterm* creates a window that emulates a VT320 series terminal. Applications written for VT100, VT220, or reGIS terminals run without modification in the *DECterm* window.

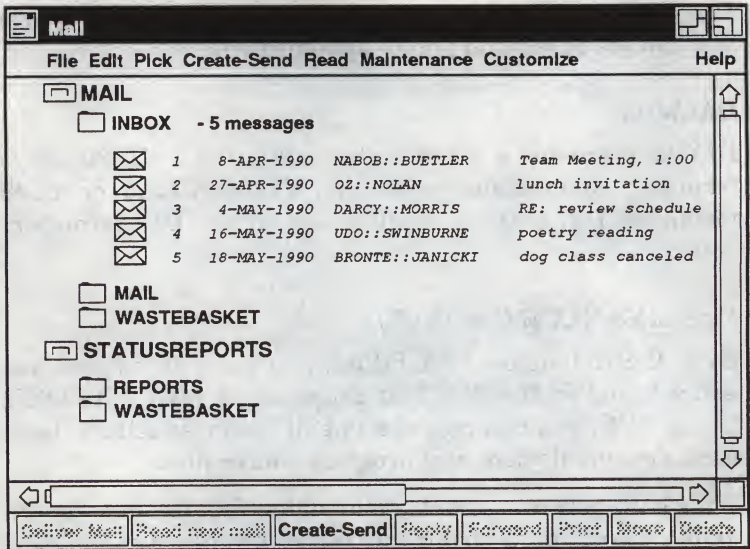
- *Extensible VAX Editor (EVE)*

*EVE*, the Extensible VAX Editor, is a general-purpose text editor based on the VAX Text Processing Utility (VAXTPU). Using *EVE*, you can create and edit business letters, technical documentation, and program source files.

With *EVE* you can search with wildcards. You can, for example, search for a string only when it appears at the start of a line, or find a combination of letters only when they are followed by a vowel. *EVE* is available on the VMS operating system only.

- *Mail*

*Mail* lets you communicate with other users on the system or network. *Mail*'s graphic interface allows you to perform the same functions as the VMS Mail Utility. Figure 4-7 shows a *Mail* window.



MLO-002702

Figure 4-7 • Mail Window

#### • Notepad Editor

The *Notepad Editor* is a basic text editor that you can use for everyday tasks such as recording messages, writing letters, and building data files.

#### • Paint

*Paint* lets you create images by “painting” or “drawing” on the screen. You can also pick shapes from a menu, select fill patterns to shade or color your picture, and use the zoom feature to magnify a particular area. Paint allows you to save or print your images or copy your picture to other applications.



- ***PostScript Viewer***

The *PostScript Viewer* uses screen fonts that correspond to printed fonts so you can see a PostScript document before you print it. You can view and page through PostScript files. The PostScript Viewer is available on the ULTRIX operating system only.

- ***Puzzle Game***

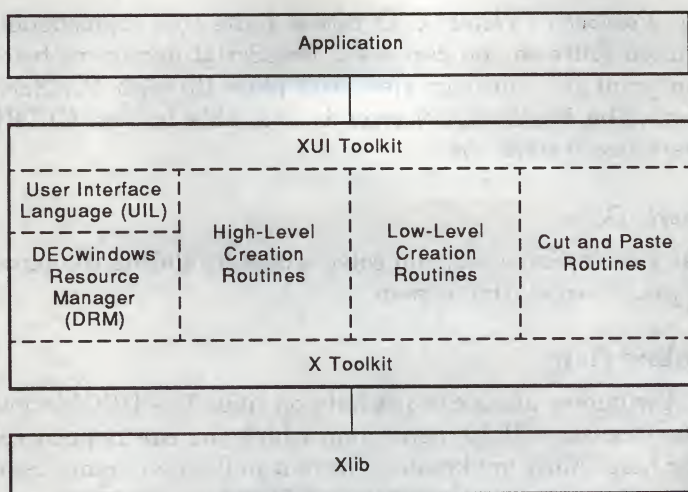
The *Puzzle Game* lets you solve a classic, sliding-tile puzzle on your workstation screen.

- **Online Help**

DECwindows users can get help on line. The DECwindows interface has a Help menu from which you can request specific help. Most applications have a pull-down menu. Some applications provide context-specific help.

- **DECwindows Programming Environment**

The *DECwindows programming environment* provides application programmers with a library of tools to write applications using the DECwindows interface. Programmers can write applications in any language, then call routines from both the XUI Toolkit and Xlib programming libraries. (XUI stands for X User Interface and Xlib stands for X library.) Figure 4-8 illustrates the programming environment. The next sections provide more details.



MLO-002703

*Figure 4-8 • DECwindows Programming Environment*

#### • *XUI Toolkit*

The *XUI Toolkit* is the key to the DECwindows programming environment. The XUI Toolkit contains everything an applications programmer needs to put a DECwindows application on another vendor's operating system that supports the X Window System. Conversely, a programmer can put another vendor's applications (if written for systems that support the X Window System) on a Digital operating system.

The XUI Toolkit consists of high-level routines for creating and managing user interface objects such as menus, scroll bars, and buttons. These routines provide an easy means to create a user interface that conforms to the DECwindows style. An additional help is the *XUI Style Guide*, which defines and illustrates the DECwindows style.

The Toolkit also includes the User Interface Language (UIL) Compiler and the DECwindows Resource Manager routines, which let you create the entire interface with a single library call. These tools also allow you to modify the interface without recompiling the entire application.

Digital's XUI/UIL has been endorsed by the Open Software Foundation as its programming interface.

- *Xlib*

Applications call *Xlib* routines from a variety of programming languages to perform basic windowing and graphics functions. An example of a basic function is to manipulate text in a window or to create, map, move, change, and destroy windows.

Xlib is Digital's implementation of the X Window System C language, graphics programming library. Digital has extended Xlib in three ways:

1. Added support for additional programming languages
2. Integrated Xlib with the VMS operating system
3. Added DECnet software and shared memory support

Xlib is the lowest level programming interface to the DECwindows environment. You can call Xlib routines from an application using the standard VAX format or the MIT C format.

- *Documentation for Programmers Developing DECwindows Applications*

The following documentation is available for software programmers who wish to develop applications for the DECwindows interface:

- *XUI Style Guide*
- *VMS Compound Document Architecture Manual*
- *VMS DECwindows Guide to Application Programming*



- *VMS DECwindows Guide to Xlib Programming: MIT C Binding*
- *VMS DECwindows Guide to Xlib Programming: VAX Binding*
- *VMS DECwindows Toolkit Routines Reference Manual*
- *VMS DECwindows Xlib Routines Reference Manual*

## ▪ **Compound Document Architecture (CDA)**

Digital offers Compound Document Architecture (CDA) products that are fully compatible with DECwindows software. Compound Document Architecture (CDA) enables each user in an organization to create and exchange revisable compound documents. A compound document integrates text and graphics. This architectural foundation consists of two products: DECwrite and DECdecision. DECwrite and DECdecision allow you to link your document's information with its source. When the source information changes, your document can be instantly revised.

Compound Document Architecture is an open and extensible foundation for the following:

- The universal interchange and merging of all data types—text, graphics, spreadsheets, charts, tables, images
- Creating, exchanging, revising, managing, mailing, viewing, and storing compound documents across a network and between multiple operating systems and applications
- Interoperability for multiple, heterogeneous systems, with many CDA applications working together in an integrated environment

The following example shows how CDA solves a typical business problem—the creation of a report.

A writer in the marketing group creates text with Digital's WPS-PLUS word processing software in ALL-IN-1. In the graphics department, an artist creates the accompanying graphics using Aldus Pagemaker or Apple. An analyst in the finance group creates the relevant financial data using DECalc or Lotus 1-2-3. In the past, text and graphic material could not be merged electronically. Using CDA, you can merge the text, graphics, and spreadsheet information into a single compound document and mail it across the network.

Digital encourages and supports third-party CDA-compliant applications that provide customers with a high level of integration. Vendors who have endorsed CDA include the following: Aldus, Apple, Ashton-Tate, Applix, Datalogics, Execucom, Keyword, Kodak, Information Dimensions, Inc., Interleaf, Molecular Design Ltd., Odesta, and Polygen.

#### ▪ DECwrite

Digital's DECwrite product is a WYSIWYG (what-you-see-is-what-you-get) editor that allows users to create and format compound documents. As noted, compound documents integrate text and graphics.

DECwrite combines WYSIWYG word processing, desktop publishing, and data charting into a single product. The Live Links feature allows live spreadsheets, charts, database information, and images to reside within DECwrite documents. When a live spreadsheet is revised, for example, the linked spreadsheet is updated automatically.

In addition to Live Links, DECwrite includes the following features:

- Word processing with spell checker, thesaurus, and support for multiple languages. Also features multiple keyboard interfaces for WPS-PLUS, EVE, EDIT, and EMACS. (EDIT and EMACS are also text editors.)

- Formatting with automatic numbering, cross referencing, multiple page styles in a document, and automatic generation of table of contents and indexes.
- Graphics editor for object oriented and freehand drawings.
- Image and PostScript file integration.

## ▪ DECdecision

Digital's DECdecision product integrates data access, a spreadsheet, and business charting so users can translate raw data into understandable information.

With the avalanche of information available, users need an easy way to understand and access data. DECdecision provides an advanced decision support solution that ensures that information is not lost in a column of figures.

Users can also exchange data among DECdecision and applications such as Lotus 1-2-3, 20-20, and dBASE, and IBM mainframe data. With Digital's Network Application Support services, users can access and communicate data across an enterprise.

DECdecision includes the following features:

- Access to local and remote data on the network, including VAX Rdb/VMS, RMS, DBMS, and IBM mainframe data. Such access provides a simplified approach to complex query, data reduction operations, and creation of personal databases.
- Calc, a windowed spreadsheet with an internal macro language and sophisticated consolidation and linking capabilities.
- Several types of charts, including bar, line, pie, area, scatter, hi-low, and histogram.



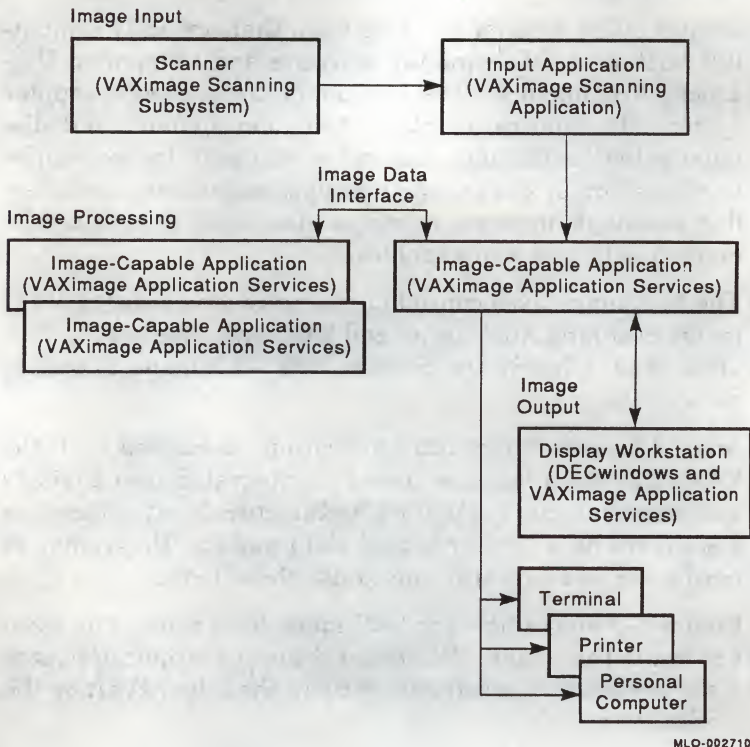
## ■ VAXimage

Digital offers a set of imaging tools that are fully compatible with both DECwindows software and Compound Document Architecture. The VAXimage tools allow computer systems to capture, display, store, manipulate, and distribute digitized images (electronic pictures). Images can be business forms, x-rays, photographs, engineering sketches, line drawings, invoices, or maps. And these images can be merged with text and graphics.

The VAXimage tools consist of two software products, VAXimage Scanning Application and VAXimage Application Services, and a hardware product, the VAXimage Scanning Subsystem.

Any VAX product can run applications developed with the VAXimage tools because they are integrated into Digital's system architecture. Digital's architecture treats images as a standard data similar to text and graphics. Programmers need no specialized training to use these tools.

Figure 4-9 shows how the VAXimage tools work: The scanner scans the image, VAXimage Scanning Application converts the image to a software format, then displays it on the workstation.



*Figure 4-9 • How VAXimage Tools Work*

Once a computer system captures an image by scanning, the image can be treated like an ordinary file. It can be displayed on a video screen along with text and graphics, printed, and incorporated into compound documents.

The VAXimage Scanning Application performs the following functions:

- Provides a software interface for hardware scanners
- Previews, adjusts, and edits images

- Creates image files on the local or remote system
- Transfers images among applications and users

After the image is captured in an electronic format, programmers can use the VAXimage Application Services to create image-capable applications. Programmers can call library routines using native-language interfaces in BASIC, FORTRAN, C, BLISS, Ada, or Pascal. The toolkit enables applications to do the following:

- Capture images
- Manipulate images, including scaling, rotating, and cropping
- Optimize image storage and transmission speed through standard data compression and decompression techniques
- Provide for image display on DECwindows workstations and other image-capable output devices

Digital treats images as a standard data type. Digital's Image Architecture (DIA) enables users to integrate image data into any application that runs on a Digital mainstream product. Dedicated equipment is unnecessary.

VAXimage Application Services supports the image data type in Digital Document Interchange Format (DDIF). DDIF is a superset of the Office Document Interchange Format (ODIF) specified by the International Organization for Standardization.

## ▪ Graphics Programming Interfaces

Digital's DEC GKS and DEC PHIGS products support industry-standard graphics interfaces for 2D and 3D graphics. DEC GKS and DEC PHIGS enable application portability across operating systems and graphical output devices. They provide FORTRAN and C language bindings for intervendor application portability. They support DECstation and VAXstation systems, VTxxx and Tektronix graphics terminals, and HP-GL, PostScript, and sixel hard-copy devices. (HP-GL is the Hewlett-Packard Graphics Language.)



DEC GKS and DEC PHIGS are integrated with Digital architectures and with industry standards.

### ▪ Graphical Kernel System

The *Graphical Kernel System (GKS)* is a high-level, device-independent graphics interface that conforms to the ANSI and ISO GKS standard. GKS specifies a set of graphics functions with which application programs can produce 2D images on graphics output devices.

DEC GKS, developed by Digital, is a callable subroutine library that conforms to the highest level of the GKS standard (2c). DEC GKS provides input and output capabilities, including workstation-independent segment storage (level 2) and full synchronous and asynchronous input capabilities (level c).

GKS is device independent and treats all devices—input or output, terminal or printer—as one logical device, called a workstation. GKS thus communicates with any device through a common interface and depends on device drivers to perform the required hardware instructions.

As a result, GKS provides application portability. Users can transfer GKS programs to any VAX or ULTRIX system regardless of the devices the system supports; they can also transfer programs to or from any other manufacturer's machines that conform to the comparable GKS level.

GKS application programs use output functions and world coordinates to describe graphics objects. An origin at zero and two perpendicular axes, X and Y, are used to specify the position of each individual point of the object. GKS has output functions for the following drawing operations:

- Draw polylines
- Place polymarkers
- Display text
- Fill a defined area

- Display an array of cells with individual colors
- Draw device-specific geometric shapes

For each output function, the user can specify a set of attributes (either predefined or user defined) that tailor the object's form, thickness, or color, for example, or control the appearance of text characters (font or spacing). Output functions can be grouped into a *segment*, which can be manipulated as a unit.

GKS accepts input from *logical* input devices. The application program either describes the characteristics of the input device or uses default characteristics. All physical input occurs through one of the following classes of logical input operations:

- *Locator*—Returns a world coordinate position
- *Stroke*—Returns a series of world coordinate positions
- *Valuator*—Returns a real number
- *Choice*—Returns a selection from a number of choices (for example, a menu)
- *String*—Returns an individual character or an entire string
- *Pick*—Returns a segment name and pick identifier

Many other GKS functions are available, including those that transform world coordinates to device coordinates, log errors, and file graphical information for external storage, exchange, and image reproduction.

You access DEC GKS functions by subroutine calls, either as specified by the ANSI standard FORTRAN binding to GKS or through the standard VMS language calls. For users who need to develop custom device drivers, DEC GKS supplies a skeleton driver and the necessary documentation.

## ▪ Programmer's Hierarchical Interactive Graphics Standard (PHIGS)

Digital's *DEC PHIGS* product is a 3D graphics support system for three-dimensional, device-independent graphics and modeling. DEC PHIGS controls the definition, modification, and display of hierarchical graphics data.

Because DEC PHIGS software is device-independent, programs written to conform to the PHIGS standard can move between operating systems with little or no change to the source code. In addition to the functionality provided by the proposed ANSI standard, Digital has extended DEC PHIGS to provide support for hidden line/hidden surface removal, *depth cueing*, and *shading*.

DEC PHIGS is designed to meet the needs of dynamic, highly interactive, 3D graphics environments. It is particularly attractive in CAD/CAM, molecular modeling, and simulation applications as well as other applications requiring interactive, 3D graphics support.

DEC PHIGS maintains a hierarchical, graphical data base called *structure storage*. Structure storage is made up of individual structure elements. Structure elements may be output *primitives* (primitives are the simplest objects in a data base), attributes, labels, application data, name set specifications, and/or transformation selections. Structures can be edited and can reference other structures, thus producing a hierarchy of structures.

Application programs for DEC PHIGS use modeling coordinates, output primitives, and primitive attributes to describe graphics objects. DEC PHIGS Version 1.0 supports the following output primitives:

- Polylines
- Polymarkers
- Text
- Fill Area



- Cell Array
- Generalized Drawing Primitive

Each output primitive has an associated set of attributes, including line type and width, color, and color intensity. Attributes associated with text primitives include character spacing, height, angle, path, and font alignment.

By dealing with a set of logical input devices, DEC PHIGS insulates the user from the differences between input devices. The logical devices supported are as follows:

- *Locator*—Returns a point in the world coordinate system
- *Valuator*—Returns a single real value in a specified range
- *Choice*—Returns a single nonnegative integer in a specified range
- *String*—Returns a string of characters
- *Pick*—Returns a pick path and pick identifier

Using DEC PHIGS software, programmers can associate individual primitives with members of a name set used to determine eligibility for highlighting, visibility, and picking. In an architectural drawing, for example, all steam pipes could be associated with one member of a name set and all water pipes with another. These sets of pipes could then be 1) made visible as a group; 2) made invisible as a group; or 3) highlighted as a group.

In addition, DEC PHIGS provides an interface that conforms to the proposed ANSI FORTRAN and C bindings to PHIGS. (A language binding specifies the syntax to be used for calling PHIGS functions in a particular language.) A specific interface for VMS (PHIGS\$) that follows the standard VMS calling convention is callable from many different languages. DEC PHIGS supports a wide variety of output devices, including HP-GL, PostScript, DEC sixel, and all Digital workstations.

## ▪ Desktop-VMS

Desktop-VMS is an easy-to-use VMS operating environment on *CDROM* (compact disk read-only memory) that integrates the VMS operating system, DECwindows software, DECnet-VAX, and VAXcluster software. Initially available for VAXstation 3100 users, it offers simplified system installation and management.

Chapter 5 describes Desktop-VMS more fully.

## Chapter 5 • Operating Systems

Digital offers two operating systems, VMS and ULTRIX. The choice depends on customer needs and requirements. Customers can use either operating system across the full range of Digital's systems.

Many customers need both the VMS and ULTRIX operating systems to solve their computing needs. Digital provides the highest possible interoperability between VMS and ULTRIX in hardware, networking, applications integration, and core applications.

### • The VMS Operating System

VMS is the general-purpose, virtual memory operating system fully developed, tested, and supported by Digital for all VAX family processors. VMS was introduced in 1978 with Digital's first VAX system (the VAX-11/780) and has been regularly enhanced and upgraded since. Each release has maintained binary compatibility with its predecessor. As a result, applications developed on past versions of VMS will execute on new versions. Also, all VAX systems offer a large selection of system utilities and application software.

In addition, the VMS operating system supports the connection of VAX systems in Local and Wide Area Networks *and* in VAXcluster configurations, where multiple VAX systems are combined and managed as one large system.

Features and components of the VMS operating system are described in a three-volume handbook set from Digital called *VAX/VMS Software*. The next sections summarize these features.



## ▪ Multipurpose Operating Environment

The VMS operating system provides a general-purpose operating environment, where real-time, batch, and time-sharing tasks can execute concurrently. Operation is controlled through commands and parameters set by the system manager or privileged user. System services handle process control, memory management, input/output operations, and system and file security. System services also provide the foundation on which "layered" system utilities and application programs operate.

Many utilities come with the operating system, including tools for editing, testing, and linking programs and for building libraries of source, object, and image modules.

More than 140 VMS software tools are available from Digital, including a full set of programming languages, tools for managing data and data bases, for analyzing performance, and for creating a protected (secure) user environment.

A large selection of application software is also available for the VMS environment, including packages for computer-aided design, graphics, technical publishing, cross-compilers, and other software used in commercial, engineering, research, and development settings. Application software that runs on VMS systems is described in a handbook set from Digital called the *VAX Software Source Book*.

## ▪ VMS Standards

For all its operational and application versatility, the VMS operating system is based on standardization:

- VMS supports one common user interface to the operating environment, the *Digital Command Language (DCL)*. DCL is an interactive language used by programmers and end users to communicate with all VMS software.
- VMS provides the *VAX Common Language Environment*, a set of programming standards that dictate consistency in interprogram communication, exception reporting, and

error handling. The Common Language Environment allows programs written in different languages to call and use one another's routines.

- VMS programming languages meet or surpass the industry standards recognized by the ANSI and ISO organizations.
- VMS networking software and protocols conform to the ISO Open System Interconnection model, an architecture governing the design of communications networks.

This commitment to standards ensures that any VAX system can run any VAX application. The same VMS operating system runs on the MicroVAX 2000 as on a VAXcluster System. Apart from application-specific hardware requirements, VMS programs and data can be transferred to any VAX/VMS processor for use.

Likewise, end users and developers can use any available VAX system for development work, debugging, and application execution. All systems operate alike through the Digital Command Language and all support standard development tools and utilities.

Finally, all VAX systems can be networked in Local Area, Wide Area, and mixed-vendor environments with full network management support. Through VMS, users have an extensive and compatible set of products that serve not only the desk top but the largest family of networked processors in the world today.

## ▪ POSIX

*POSIX (Portable Operating System Interface for Computer Environments)* has gained wide support throughout the computer industry as the definitive standard for an operating system interface. Both the Open Software Foundation and X/Open are basing their open software environments on POSIX. POSIX was approved as a formal IEEE standard in August, 1988.

Digital plans to implement the IEEE 1003.1 POSIX interface within the VMS kernel. Applications written to conform to the POSIX specification will run on any operating system that conforms to POSIX. This allows applications software to run on multiple operating systems.

## ▪ **Desktop-VMS Software**

Desktop-VMS Software is the VMS operating system on a CDROM. Initially available for VAXstation 3100 users, this easy-to-use VMS environment, which includes DECnet and Local Area VAXcluster software, is designed for non-technical professionals.

## ▪ **Desktop-VMS Features**

Desktop-VMS Software has the following features:

- Easy-to-install VMS operating system on CDROM
- Simplified configuration of VAXstation 3100 clusters
- DECwindows user interface
- Simplified system management
- Online documentation
- Preinstalled, layered applications for the desktop

## ▪ *Easy Installation*

Installing Desktop-VMS Software is simple because the components—VMS, DECnet-VAX, VAXcluster, and Desktop-VMS “ease-of-use” software—are already integrated and installed on the CDROM. To install the VMS operating system, you power on the workstation, insert the Desktop-VMS Software CDROM, and answer a few simple configuration questions.



- *Simplified VAXcluster Configuration*

Installing a VAXstation 3100 cluster is similar to installing a standalone system. Users can add "satellite" workstations to a cluster by answering an additional set of configuration questions.

- *"Point and Click" DECwindows User Interface*

VMS DECwindows software provides users with a "point-and-click" interface to the VMS operating system and applications. Users call applications and perform tasks by selecting functions from graphical menus, rather than typing commands. DECwindows allows users to run multiple applications in multiple windows simultaneously, thus improving productivity.

- *System Management Made Simple*

With Desktop-VMS Software, system management does not require experience with VMS. A DECwindows interface shows only those functions necessary to manage the Desktop-VMS Software environment. The system manager uses menus to manage users, set up printers, back up files, install layered products, and manage a VAXstation 3100 cluster.

- *Online Documentation*

Both hardcopy and online Desktop-VMS documentation is provided. The DECwindows online Bookreader lets users page through a selected manual or select entries from the manual's index or table of contents.

- *Integrated Applications*

The CDROM also contains pre-installed software for the following layered products. Customers who purchase a license for these layered products receive a Product Authorization Key (PAK) so they can access the software.

- **Distributed System Services (DSS).** Allows users to treat remote network resources as if they were local. Current DSS products include:
  - VAX Distributed File Service (DFS). Provides local access to remote VMS disk resources.
  - VAX Distributed Queuing Services (DQS). Provides local access to remote VMS printers.
- **VAXpc for VMS software.** This is a DECwindows application program that emulates an IBM PC AT computer, enabling VAXstation users to access PC applications.

## ▪ **The ULTRIX Operating System**

ULTRIX Worksystems Software (described in the next section) uses ULTRIX-32, Digital's enhanced version of the UNIX operating system.

UNIX was developed in the late 1960s at Bell Laboratories, using Digital's PDP-7 and PDP-11 computer systems. The initial set of programming utilities was expanded into an operating system, written in the C language, and made available to users under license by Bell Laboratories. By the late 1970s, several versions of UNIX were running on a variety of machines. Today, the two most widely recognized versions are the University of California at Berkeley's BSD (Berkeley Software Distribution) and AT&T's UNIX System V.

ULTRIX-32, which is based on the UNIX version 4.2BSD, supports many features of Volume 1 of the System V Interface definition. ULTRIX offers more than 200 of the most popular utilities and commands from both environments.

Through the ULTRIX operating system, ULTRIX Worksystems Software provides an industry-standard environment with the flexibility and portability valued by UNIX users. Utilities and commands give users control over the operation of the processor, virtual memory management, input

and output, the hierarchical file system, and interprocess communication.

The system supports both the *Bourne* and *C shells*—command language interpreters that provide an interactive user interface while also serving as programming languages. The Bourne shell, developed for interactive and programming use, has a syntax similar to *ALGOL*. The C shell includes many features that enhance its use as an interactive command interpreter and uses a C-like syntax.

The system also supports a large library of commands for information management, document preparation, program development, networking and communications, and system management activities.

In addition, ULTRIX systems can participate in TCP/IP and optional DECnet networks and can transparently share files with other systems in the network, using the Network File System (NFS).

#### • **ULTRIX Worksystems Software**

The set of application software that supports Digital's traditional workstation family is called *ULTRIX Worksystems Software*. ULTRIX Worksystems Software combines Digital's ULTRIX operating system with sophisticated graphics software (based on the X Window System) to provide an integrated UNIX workstation environment.

ULTRIX Worksystems Software offers a unique workstation solution. Users can develop and run applications based on an industry-standard, portable operating system environment that is used worldwide—the UNIX operating system.

At the same time, a workstation based on ULTRIX is a member of Digital's VAX family. Apart from application-specific hardware requirements, programs and data that are developed on one ULTRIX system can be transferred to any other ULTRIX system for use. Thus, end users and developers can take advantage of any available VAX system based



on ULTRIX for cross-development work and for application execution.

## ▪ Graphics Software and Application Support

ULTRIX Worksystems Software includes graphics software that provides a tailorable user interface and windowing and graphics programming interfaces. The software employs the X Window System, which allows graphics to be sent over a TCP/IP network.

A variety of optional application software is available: packages for computer-aided design, computer-aided engineering, cross-compilers, and graphics used in engineering, research, and technical settings. Packages that run on ULTRIX systems are described in Digital's *ULTRIX Software Source Book*.

ULTRIX system users also have the tools to link their environment with the VMS environment if they want to share or convert applications and data.

## ▪ Graphics Subsystem Components

The following graphics subsystem components comprise the ULTRIX Worksystems Software:

- The default ULTRIX Window Manager (UWM)
- Terminal emulation software (VT102, TEK4010)
- Graphics programming interfaces (X Window System, Video Driver Interface Library, GKS)
- Sets of user and programming utilities

## **Chapter 6 • Networking and Integration**

This chapter discusses workstations and networking in the VMS, ULTRIX, and MS-DOS environments and describes Digital's Personal Computing Systems Architecture (PCSA) for integrating PCs in a network.

Digital is committed to multivendor networking and to integrating DECnet software with Open Systems Interconnect (OSI) and telecommunications standards. DECnet/OSI software, known as DECnet Phase V, provides a single, open network environment where VMS, UNIX, and MS-DOS systems, and larger mainframe and supercomputer systems, can work together.

Digital has developed products to link desktop terminals and IBM, COMPAQ, Olivetti, and other industry-standard personal computers into DECnet/OSI networks. Digital has developed "gateways" to link DECnet/OSI and IBM SNA networks and to provide VAX system users with direct access to Cray supercomputers. In addition, Digital is working with Apple Computer, Inc., to establish standards for the integration of Macintosh computers and Appletalk networks into enterprisewide DECnet/OSI networks.

### **• Networking in the VMS Environment**

A VAXstation workstation supplies high-performance graphics processing and comprehensive system and application software in a self-contained, dedicated computer system. Users, therefore, have the option to work autonomously.

However, VAXstation users often prefer to belong to a larger system environment where they can share the resources of their work group (and lower the associated expenses) and where system administrative duties are handled for them. Networking makes this possible.

A *network* consists of two or more devices—computer systems, intelligent terminals, or intelligent peripherals—linked to exchange information and share resources. Because they belong to a network, users have immediate, on-line access to systems, applications, and information located elsewhere in the network.

Digital's networking services offer VMS system users convenient alternatives for resource and system management:

- VAXcluster Systems
  - DECnet System Services
    - Distributed Naming Service
    - Distributed File Service
    - Distributed Queing Service
    - Remote System Manager
  - DECnet networks
- **VAXcluster Systems**

*Clustering* is a way of closely interconnecting VAX processors so that they can perform—and be managed—as a single, highly powerful system.

Clustering initially combined Digital's larger VAX processors in an arrangement called a VAXcluster System. Connected by a high-performance bus (the Computer Interconnect), the processors in a VAXcluster System share storage, applications, and other system resources in a flexible, yet centrally controlled configuration.

A similar arrangement, called Local Area VAXcluster Systems, is available for VAXstation and MicroVAX systems.

A Local Area VAXcluster System accommodates up to 42 VAX systems—either VAXstation workstations or other VAX systems. The Local Area VAXcluster System uses Ethernet as the interconnect medium rather than using the Computer Interconnect. Systems may be placed anywhere on



the Ethernet, but are designated as belonging to the cluster. The systems belonging to the Local Area VAXcluster System are treated as one large system that offers its users the following benefits:

- *Central System Management.* A single system manager has responsibility for software installation, file backups, system security, and resource management for *all* members of the cluster.
- *Distributed Processing.* The system manager can establish clusterwide batch queues that distribute batch jobs around the cluster.
- *Resource Sharing.* Individual VAXstation workstations can have access to CPU power, disks, printers, plotters, applications, and data located at other workstations and systems throughout the cluster. In fact, files are transparently accessible across the system.
- *Batch and Print Load Balancing.* The system manager can create generic batch and print queues that serve cluster members. Clusterwide queues allow jobs to be executed on the most available processor. Queues can be distributed to take advantage of conveniently placed or less heavily used devices.
- *Increased Availability.* Users can gain access to the Local Area VAXcluster System through any member system. If one workstation is unavailable, a user can work from any other.

For each group of systems in the Local Area VAXcluster System, one system is called the *boot member* and is connected to a VMS system disk. This disk contains the common and individual startup files, system authorization files, and directories from which the other systems or *satellite members* are booted.

For a Local Area VAXcluster System, the boot member can be a VAXserver; VAXstation 2000, 3200, or 3500; VAXstation 3100 Model 40; VAXserver 3400; or MicroVAX II system or

any larger VAX system. For a mixed-interconnect VAXcluster System, any CI-based system can be the boot node. A VAXserver device is specifically configured for use as a boot member or file server. Either VAXstation or MicroVAX systems can be satellite systems. In a Local Area VAXcluster System, the boot member normally provides print and file services (printers, plotters, and system and data disks) for the cluster. The system manager configures the arrangement to balance processing across the cluster and to make productive use of cluster components.

For example, the manager can have disk storage and peripherals located centrally at the boot member or distributed clusterwide. The manager can define generic batch and print queues so that queued requests will go to the next available system for processing or to a designated, perhaps dedicated, system. Data and applications can reside anywhere on the cluster for transparent access by a user at any system in the cluster.

Satellite systems can easily be added to the Local Area VAXcluster System (to a maximum of 42) at any time. More than one VAXcluster System can share the same Ethernet, which in turn is available to other systems for other forms of network communication.

VAXcluster Systems can share the same Ethernet with other standalone or Local Area VAXcluster System configurations. If heavy traffic requires, an Ethernet LAN Bridge 100 may be added to isolate cluster traffic on a particular segment.

Figure 6-1 shows a VAXcluster System that shares an extended Ethernet with other clustered and networked systems.

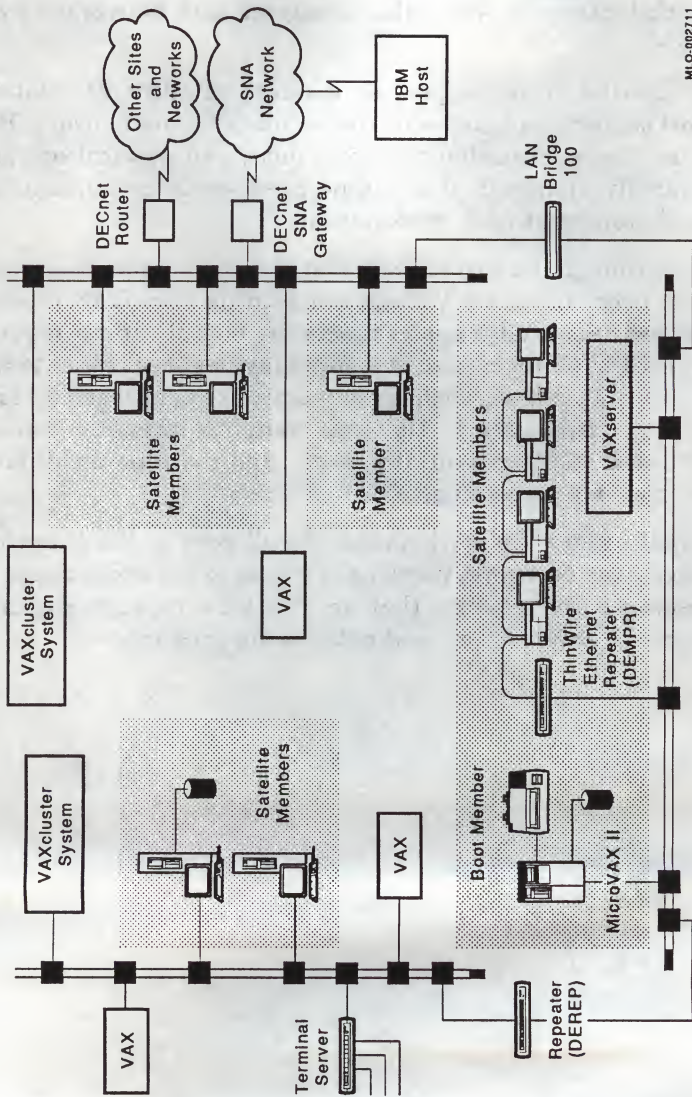
VAXcluster Systems provide diskless satellite VAXstation workstations as a cost-effective solution for many users. Because the workstation software, data, and applications are centrally managed, there is no need for large amounts of local storage at each workstation.

Even though the system manager controls cluster resources, each user still has a VAXstation with its MicroVAX processor and dedicated graphics functions. If applications require high CPU performance, the user may use local disks to accelerate activities, such as managing system memory and paging. Applications that are compute intensive can be offloaded to the potentially larger and more powerful boot member for processing.

Finally, since the workstation is still part of the Ethernet Local Area Network, users have access to the wider range of resources and systems that are available through Digital's Network Architecture and networking products.







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Figure 6-1 • VAXcluster System

## ▪ **DECnet Systems Services (DSS)**

*DECnet Systems Services (DSS)* allows VAXstation users to share data, printers, and system management. DSS consists of four products, which are each sold separately. You choose which services will be used on which systems. You also choose centralized or distributed management styles for each system, since both styles can coexist within a network.

Using DSS between VAXclusters is an excellent way to get truly distributed processing. The products are described in this section.

## ▪ *VAX Distributed Name Service (DNS)*

VAX Distributed Name Service is a global name facility used by the VAX Distributed File Service and the Remote System Management products. This Distributed Name Service provides unique, networkwide names for DFS file directories and RMS clients.

## ▪ *Remote System Manager (RSM)*

VAXstation users who are part of a Local Area Network but who do not wish to belong to a Local Area VAXcluster System can take advantage of Digital's optional *Remote System Manager (RSM)* software.

RSM offers central system management for distributed VAX systems located anywhere on an Ethernet Local Area Network. One system functions as a server to the other (client) systems. The server acts as the distribution point for installing system and application software on client systems, for updating the software, and for backing up and restoring files for clients. It can also serve as a central print queue.

Remote systems continue to function autonomously, however. Each client system is dedicated to its user and keeps its own copy of the operating system and application software on local disks.

VAX/VMS systems can act as both servers and clients; ULTRIX nodes can act as clients.

- *VAX Distributed Queuing Service (DQS)*

VAX Distributed Queuing Service makes printers available as a networkwide resource. Users can use the VMS PRINT command to print on any printer in the network. New printers can easily be added to the network, thus reducing printer hardware and management costs.

- *VAX Distributed File Service (DFS)*

VAX Distributed File Service permits high-speed transparent access to disks and shared libraries that reside elsewhere in the network. Performance of VAX Distributed File Service closely matches that of a Local Area VAXcluster System. The first release of DFS restricts the use of simultaneous writes to the same file.

- **The Digital Network Architecture and DECnet-VAX**

A prime advantage of using a VAXstation workstation is that it can be part of a large Digital network, whose users have immediate, online access to systems, applications, and information located elsewhere on the network.

Most networks evolve in much the same way as the organizations to which they belong. The network starts by serving a work group or department. As the group grows, the network gains new systems and equipment and links to other systems and networks in other departments. With Digital's networking options, organizations can add, move, and remove systems and equipment in their network whenever necessary, with minimal disruption to other network users.

DECnet software is built on a framework, introduced by Digital in the early 1970s, called the Digital Network Architecture (DNA). DNA in turn is very similar to the ISO model for Open Systems Interconnection (OSI). Figure 6-2 shows their similarity.



ISO 7-Layer Model		DNA Layers
Application		User
		Network Management
Presentation		Network Application
Session		Session Control
Transport		End Communications
Network		Routing
Data Link		Data Link
Physical		Physical Link

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*Figure 6-2 ■ ISO and DNA Models*

Each layer provides a subset of services to the network functions. The lower layers define the physical links that connect devices to the network, while the middle layers set up the logical links that allow reliable communication between systems. The upper layers are reserved for applications.

The DNA framework is transparent to most user activities. Thus, network users need not be concerned with how data physically moves between nodes. Of more importance is how the network can simplify and increase data sharing.

As a DECnet node, any Digital workstation can share data and resources with any other system in the network, local or remote. Thus, the user can communicate with other Digital systems running VMS, ULTRIX, DOS, RSX, and TOPS, with other Digital computer systems, and even with the systems and networks of other manufacturers. Optional *servers, gateways, and routers* provide the necessary protocols and interfaces for data exchange. The SNA Gateway,

for example, lets a Digital system communicate with IBM systems.

Thus, besides being able to access the resources of a user's immediate department, a VAXstation node can reach the resources of the entire organization. Using the workstation's multiple windows, a user can share applications and data with many systems at once, anywhere on the network.

Specific DECnet-VAX functions include:

- *Task-to-Task Communication.* An application on one system can establish a logical link with an application on a remote system. Once the link has been established, the programs can communicate as though both were executing locally. DECnet software manages formatting, checking, and transmission of program messages.
- *Remote File Transfer and Access.* A user or application with appropriate privileges can transfer files to or from another system and access files, data, and peripherals located at another system. Command parameters are used to indicate the system node names and to establish log-in security information needed to effect the operation.
- *Remote Command File/Batch File Submission and Execution.* A user at one system can request another system to begin the execution of a command file or batch file. The file can be located at the other system or can be sent with the request.
- *Network Virtual Terminals.* A user of one system can log in to a remote system. Once the connection is made, the user works as though directly attached to the remote system.

- *Downline System/Task Loading.* A user may develop software on one system and send it to a target RSX-11S or DECnet-11 system where it will ultimately be used.
- *Upline Dumping.* An RSX-11S system or communications server can automatically send a system-image dump to an adjacent node if the RSX-11S system or communications server fails.

Digital's DECnet-VAX software also provides substantial network management tools through the NCP (Network Control Program) utility. A system manager uses NCP to configure a system as a node in a network and to perform network management and maintenance functions for that node and other nodes in the network. Management functions include defining the network components and their parameters, configuring the network to ensure proper routing, controlling and monitoring local and remote network operations, and testing network components.

Through the network's virtual terminal support and the workstation's multiwindowing, a system manager can be logged in to many networked systems at once and directly oversee user activity.

Figure 6-3 shows a Wide Area Network.



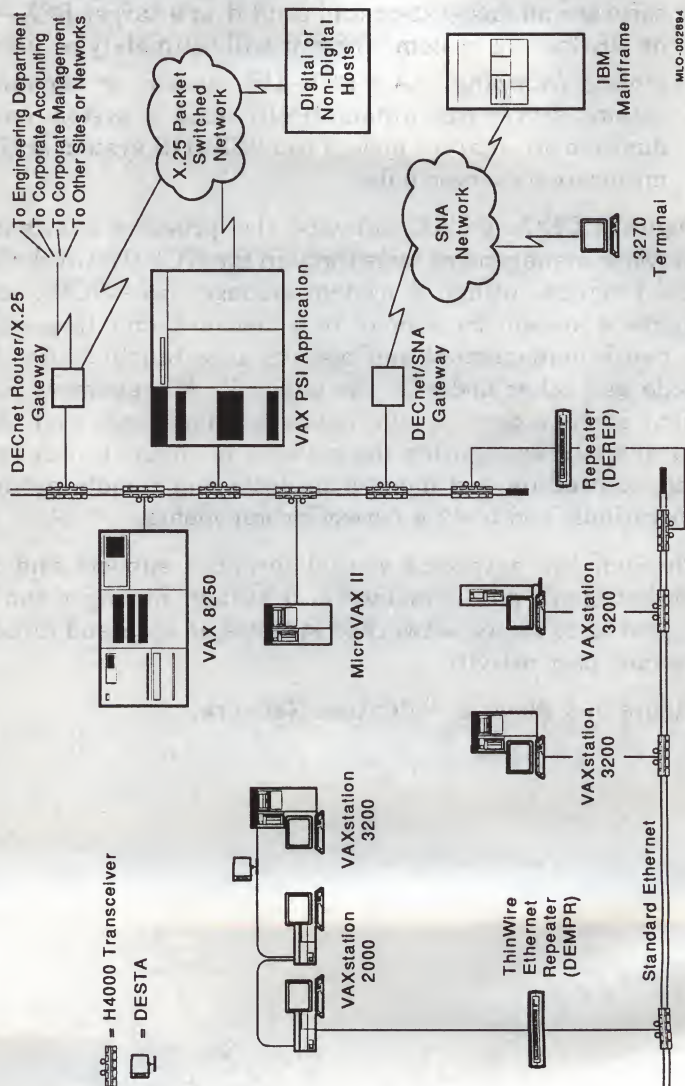


Figure 6-3 • Wide Area Network

## ▪ Networking in the ULTRIX Environment

A Digital workstation supplies high-performance graphics processing and comprehensive system and application software in a self-contained, dedicated computer system. Therefore, its user has the option to work autonomously.

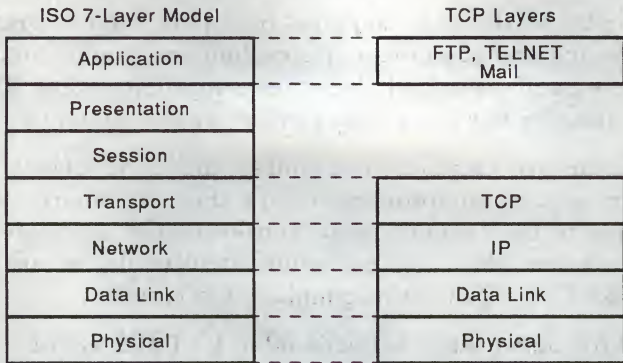
However, workstation users often prefer to belong to a larger system environment where they can share the resources of their work group (and lower the associated expenses) and where system administrative duties are handled for them. Networking makes this possible.

Digital's networking services offer ULTRIX system users convenient alternatives for resource and system management:

- DECnet networks
- TCP/IP networks
- Network File System

## ▪ The TCP/IP Network Protocol

The *TCP/IP* network protocol is a set of software communications protocols widely used in UNIX operating environments. TCP/IP is an integral part of the ULTRIX operating system and offers many of the same networking services defined in the lower four layers of the ISO 7-layer model for Open Systems Interconnection (OSI). (See Figure 6-4.)



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*Figure 6-4 • ISO and TCP Models*

Each layer in the ISO model contributes a subset of services to the selection of network functions available to the user. The lower layers define the physical links that connect devices to the network, while the middle layers set up the logical links that allow reliable communication between systems. The upper layers are reserved for applications. The TCP/IP functions include:

- *Task-to-Task Communication.* An application on one system can establish a logical link with an application on a remote system. Once the link has been established, the programs can communicate as though both were executing locally.
- *Remote File Transfer and Access. (FTP)* A user or application with the appropriate privileges can transfer files to or from another system and access files, data, and peripherals located at another system.
- *Remote File Execution.* A user at one system can request another system to begin the execution of a command or batch file. The file can be located at the other system or can be sent with the request.



- *Network Virtual Terminal.* A user of one system can log in to a remote system. Once the connection is made, the user works as though directly attached to the remote system.

Through TCP/IP, a workstation user can communicate with other systems that also use the TCP/IP protocols, including all ULTRIX systems and systems on other networks, such as the ARPANET, MILNET, and Defense Data Network.

## ▪ Network File System

The Network File System (NFS) governs file sharing among networked systems. NFS is independent of the operating system. Thus, file sharing can occur among any workstations, systems, operating systems, and networks that choose to use it: Specifically, NFS supports:

- Transparent file sharing through the use of remote file systems
- Network administration through the use of the *Yellow Pages* facility

NFS lets ULTRIX system users transparently access and share files in a network. Sharing is accomplished through remote file systems. A server system makes its file systems and directories available to requesting systems called *clients*. Once the client system has mounted a server's file system or directory (using the *mount* command), its users can read and write files as though they were working locally. Any system can act as a client, a server, or both.

The server system can limit access to its file systems to specific clients. Since NFS does not support remote file region locking, however, it is possible for several clients to write to the same file simultaneously.

NFS also provides a network administrative service called *Yellow Pages*. *Yellow Pages* is a set of cooperating server processes that distributes and maintains data needed in defining the network, its users, and services. Such data includes the password file, a list of file systems available for mounting, and host names and identifications.

*Yellow Pages* gives the network managers of client systems centralized access to this distributed data. When a change or update is required (as when a client system wishes to add a new user to the network), the client updates *Yellow Pages*, which in turn updates all other necessary data files automatically.

NFS offers the work group several conveniences.

- Many workstations can share a single copy of a file.
- A server or central VAX system can function as a file server for several workstations, so NFS helps reduce the need for large amounts of local storage at each workstation.
- In an NFS environment, a VAXserver acts like an ULTRIX file server that any ULTRIX or UNIX node can access.
- In addition, NFS with *Yellow Pages* can simplify the network administration activities associated with a designated group of Digital workstation users.

Figure 6-5 shows a network in which workstations and systems based on ULTRIX share files through NFS and share the network with other systems.





## ▪ The Digital Network Architecture and DECnet-ULTRIX

DECnet-ULTRIX is Digital's optional networking product that enables communication among VAX systems based on ULTRIX. DECnet software is built on a framework introduced by Digital in the early 1970s called the Digital Network Architecture (DNA). DNA in turn is similar to the ISO 7-layer model.

The DNA framework is transparent to most user activities. Thus, network users need not be concerned with how data physically moves between nodes. Of more importance is how the network can simplify and increase data sharing.

As a DECnet node, each workstation can share data and resources with any other system in the network, local or remote. Thus, the user can communicate with other RISC or VAX systems running the ULTRIX operating system, with other Digital computer systems, and with the systems of other manufacturers. *Servers, gateways, and routers* provide the necessary protocols and interfaces for data exchange.

Thus, besides being able to access the resources of one's immediate department, a workstation node can reach the resources of the entire organization. Using the workstation's multiple windows, a user can share applications and data with many systems at once, anywhere on the network.

Specific DECnet-ULTRIX functions include the following:

- *Task-to-Task Communication.* An application on one system can establish a logical link with an application on a remote system. Once the link has been established, the programs can communicate as though both were executing locally. DECnet software manages all formatting, checking, and transmission of program messages.
- *Remote File Transfer and Access.* A user or application with the appropriate privileges can transfer files to or

from another system and access files, data, and peripherals located at another system. Command parameters are used to indicate the system node names and to establish log-in security information needed to effect the operation.

- *Remote File Submission and Execution.* A user at one system can request another system to begin the execution of a command file or batch file. The file can be located at the other system or can be sent with the request.
- *Network Virtual Terminals.* A user of one system can log in to a remote system. Once the connection is made, the user works as though directly attached to the remote system.

Digital's DECnet-ULTRIX software also provides substantial network management tools through the NCP (Network Control Program) utility. A system manager uses NCP to configure a system as a node in a network and to perform network management and maintenance functions for that node and for others in the network. Management functions include defining the network components and their parameters, configuring the network to ensure proper routing, controlling and monitoring local and remote network operations, and testing network components.

Through the network's virtual terminal support and the workstation's multiwindowing, a system manager can be logged in to many networked systems at once and directly oversee user activity.

TCP/IP hosts can talk to each other by file transfer, remote login, and mail, using the DECnet-ULTRIX Internet Gateway.

Figure 6-3 shows a Wide Area Network.

## ▪ **VMS/ULTRIX Connection**

The VMS/ULTRIX Connection is a software product that connects VMS systems with UNIX workstations. It permits customers to communicate between the two operating systems and share data and resources.

The VMS/ULTRIX Connection supports Internet networking protocols and provides an NFS server on VAX/VMS.

## ▪ **Internet**

Internet is a worldwide interconnection of 1,000 networks using Department of Defense protocols. The most prominent Internet protocol is TCP/IP, the byte-stream protocol supported by 150 vendors. TCP/IP is a de facto UNIX standard for networking.

Version 1.0 of the VMS/ULTRIX Connection supports the following Internet protocols:

- Transmission Control Protocol (TCP)
- Internet Protocol (IP)
- User Datagram Protocol (UDP)
- Internet Control Message Protocol (ICMP)
- Address Resolution Protocol (ARP)
- File Transfer Protocol (FTP)

## ▪ **NFS Server**

The VMS/ULTRIX Connection provides an NFS server. (NFS is the Network File System.) NFS provides UNIX clients with transparent access to remote file systems. The NFS server promotes data sharing between clients by providing a central data storage facility for VMS and UNIX file systems. UNIX clients can access either VMS StreamLF files or files compatible with UNIX stored on the VMS server. VMS files must conform to VMS file naming and directory rules; files compatible with UNIX must conform to ULTRIX file naming and directory rules.



The UNIX files on the NFS server are completely compatible with the ULTRIX File System (UFS) or Fast File System. This ensures that existing UNIX applications can access the files without any changes. VMS applications can also access the files compatible with UNIX using RMS (Record Management Services).

The VMS/ULTRIX Connection includes a set of management commands. These commands are designed to help the VAX/VMS system manager monitor and control Internet communications and the NFS server within the VMS environment. Examples of management commands are ADD, REMOVE, and SHOW EXPORT. These commands allow the system manager to control which NFS clients have access to the file systems compatible with UNIX on VAX/VMS.

## ▪ Networking in the MS-DOS Environment

Every Digital workstation has an optional MS-DOS capability. You can run MS-DOS applications locally on your workstation or across the network.

Depending on which operating system you wish to use as the primary system, Digital offers the following options for running MS-DOS as shown in Table 6-1 and Table 6-2.

**Table 6-1 • MS-DOS Under VMS**

<b>Product</b>	<b>Windowing System</b>
VAXpc	DECwindows
SoftPC	UIS
386ware	DECwindows and UIS

**Table 6-2 • MS-DOS Under ULTRIX**

<b>Product</b>	<b>Windowing System</b>
SoftPC	DECwindows
386ware	DECwindows and UIS

### ▪ **MS-DOS Server**

An MS-DOS server is available that allows VAXstation users access to MS-DOS applications such as word processing, mail, spreadsheets, and personal database managers. These applications can be accessed in one or more windows on a VAXstation workstation or on a terminal attached to a VAX or MicroVAX system. You can use MS-DOS applications in a DECwindows environment by displaying the application in a DECterm window. The server, called the 386ware, is provided by Logcraft, of Nashua, New Hampshire. This server resides on an Ethernet (ThinWire or thickwire) and can support up to eight simultaneous users on the same machine or on different machines.

If required, multiple MS-DOS servers can reside on an Ethernet, thus supporting more than eight users.

### ▪ **VAXpc and SoftPC**

Digital's VAXpc and Insignia's SoftPC for VMS are software application programs that allow your VAX workstation to have the features of an IBM Personal Computer AT. Essentially, you have a PC clone on your workstation without installing any additional hardware. You can run standalone DOS-based PC applications that do not require special hardware or protected mode.

VAXpc is for VAX/VMS DECwindows, while SoftPC is for VAX/VMS UIS and VAX/ULTRIX DECwindows.

### ▪ *PC Hardware Environment*

The VAXpc and SoftPC software create an emulated (imitated) PC hardware environment. This includes:

- Two virtual hard disks that contain all the standard DOS operating system software. (A virtual disk is a file on a VAX disk that you can access as a DOS drive. You use the virtual disk space as if it were an MS-DOS disk.)
- A physical diskette service, if you have a diskette drive on your system.
- An IBM Personal Computer AT enhanced keyboard.
- LPT emulation—LPT is the DOS device name for parallel printers. DOS printer devices can be attached to either a VAX queue or a spooled device. Queues and spooled devices put printing requests in a waiting line and print the files one after the other.
- CGA and Hercules video

In addition, you can use a Setup utility to change your hardware environment.

### ▪ *What VAXpc and SoftPC Can Do*

VAXpc and SoftPC feature a graphic user interface that provides access to the operating system that runs DOS applications.

With VAXpc and SoftPC you can:

- Execute DOS commands
- Install and run standard DOS applications
- Copy files between VAX and DOS operating systems using a utility

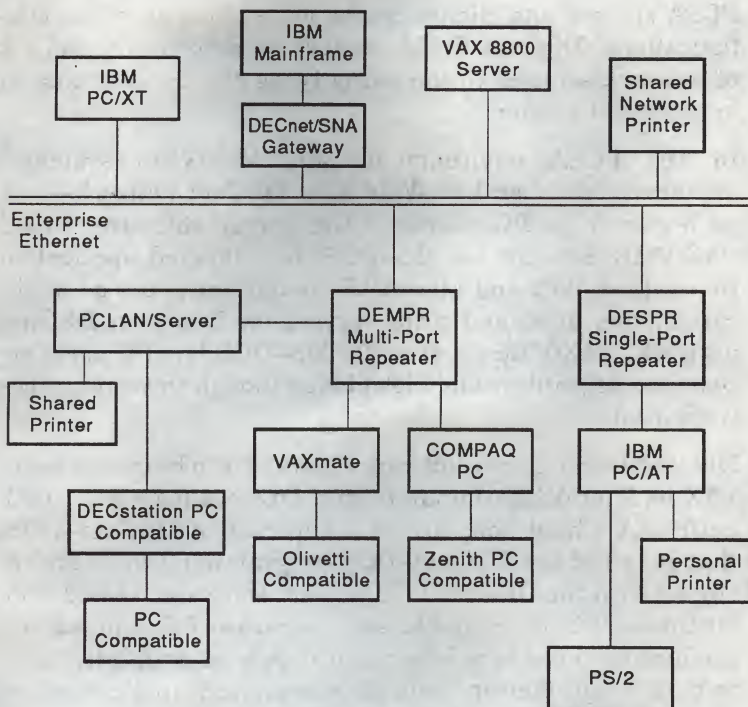


## ▪ Integrating PCs in a Network

Digital's Personal Computing Systems Architecture (PCSA) integrates personal computers from Digital, IBM, COMPAQ, Olivetti, Zenith, and other vendors into a PC LAN or corporate computing network. Using PCSA, PCs use VAX/VMS computers as servers and share information and resources with other users on the corporate network. PCSA provides:

- Direct access to shared applications and data files anywhere on the network
- Direct access to physical resources, such as disks, printers, and network gateways located on the network
- Simplified, centralized management of PCs plus the benefits of standalone personal computing
- Integrated MS-DOS and VAX/VMS environments
- Multivendor compatibility based on DECnet/OSI, MS-NET, MS-DOS, and NETBIOS
- Flexible, incremental growth for your PC networks

Figure 6-6 shows a sample PCSA configuration.



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**Figure 6-6 • Sample PCSA Configuration**

## ▪ **Servers and Clients**

PCSA servers and clients can be joined into countless configurations. Digital's PCSA product set delivers the full set of network services to the many types of PCs that exist in organizations today.

In the PCSA environment, any VAX/VMS system—anywhere on a Local or Wide Area DECnet network—acts as a server to PC clients. The server software, called VAX/VMS Services for MS-DOS, is a layered application that allows VAX and MicroVAX computers to act as application, file, disk, and print servers for PCs in a DECnet network. VAX/VMS Services for MS-DOS lets PC users access remote printers and disk files as though these resources were local.

DECnet/PCSA Client software allows PCs to be connected to VAX or MicroVAX computers in a DECnet network. DECnet/PCSA Client software is a superset of DECnet-DOS, that is, all of the DETnet-DOS programming tools are included with the DECnet/PCSA Client software. In addition, DECnet-DOS is available as a separate PC connectivity product for PC users who require only or primarily task-to-task programming tools for customized applications or access to ULTRIX or RSX operating systems.

Both Digital and selected non-Digital PC workstations work equally well in network configurations ranging from standalone PC LANs for a small organization to fully configured DECconnect networks that integrate data and video communications into a comprehensive, enterprisewide network.

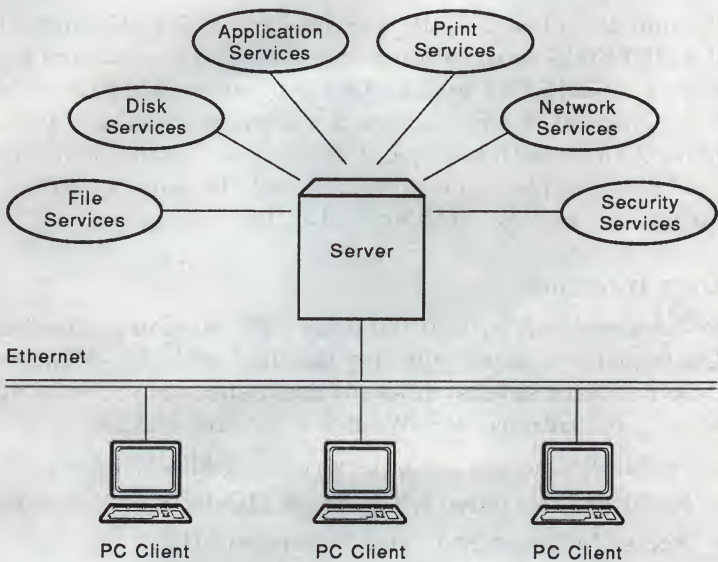
## ▪ **Network Management**

All networks require some degree of network management. Digital's Remote System Manager is helpful in managing multiple PC servers. PCSA provides the following guidelines for setting up and managing a network environment:



- Assigning user privileges and system access
- Assigning print queues
- Allocating disk space
- Maintaining and upgrading server-based PC applications
- Devising custom integrated solutions
- Performing disk backups

Figure 6-7 illustrates the PCSA server/client relationship.



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*Figure 6-7 • PCSA Server/Client Relationship*

## ▪ **Network Security**

PCSA provides security procedures for PCSA file servers and virtual disk services that protect PC information from unauthorized access. These security measures, however, do not restrict authorized users from working comfortably with the network. With PCSA, authorized users can use services such as the application interface to load third-party software and to create custom programs that run on the network.

## ▪ **Programming Interface**

Version 2.x of VAX/VMS Services for MS-DOS supports the NETBIOS programming interface to create custom programs. NETBIOS applications run unmodified on client PCs. NETBIOS applications can then communicate transparently over both LANs and Wide Area Networks (WANs). NETBIOS applications also can talk to non-PC DECnet nodes such as VAX/VMS and ULTRIX.

## ▪ **User Interface**

PCSA uses the Microsoft Windows (MS-Windows) interface. Consequently, users who are familiar with MS-Windows need not learn several different command sequences for different applications. MS-Windows features include:

- Portability across computers running MS-Windows
- Multiple interactive windows for MS-DOS applications
- Access to Graphics Device Interface (GDI)
- Data exchange between applications

Users who are unfamiliar with the MS-Windows interface can execute MS-DOS commands at the DOS prompt.

## ▪ Network Applications Support

Digital's Network Applications Support (NAS) is a distributed, enterprisewide computing strategy. Digital's PC integration products are a part of the NAS strategy. NAS allows customers to use a mixed set of systems, applications, and resources as a single, unified whole and has the ability to grow with future technological changes.

This spectrum of application sharing and networked communications is made possible by DECnet/OSI. DECnet provides the communications protocols that allow different types of hardware and software equipment to interact almost seamlessly.

To meet customers' needs, Digital is integrating Macintosh, MS-DOS, and OS/2 desktop architectures—in addition to VMS and UNIX—into LANs and WANs. These services include applications access, business communications, and information resource sharing.

These features carry over into international applications as well. Digital is a leader in supporting international character sets to enhance usability of PCSA products worldwide.

## ▪ Communications Hardware

The communications hardware that comes with every Digital workstation is the Ethernet controller with internal cabling and port, and the modem port. Additional cabling, connectors, adapters, transceivers, modems, and other devices are available as separate options. The primary networking technology for Digital workstations is Ethernet Local Area Networks.

For AT-compatible PCs and Digital PCs, Digital offers an optional, multibuffered PC Ethernet controller.



## ▪ Local Area Networks

A *Local Area Network (LAN)* is a privately owned communications network. Digital's Local Area Networks are implemented using Ethernet, a standard 10 Mbits-per-second connection accommodating *baseband* (single channel) or *broadband* (multiple channel) signaling techniques.

### ▪ Standard Ethernet

Standard (or thickwire) Ethernet coaxial cable is used for communications between floors and buildings. A single segment of coaxial cable can be up to 500 meters long (1640 feet). Segments can be linked through *barrel connectors*, *repeaters*, or *bridges*.

### ▪ ThinWire Ethernet

ThinWire Ethernet coaxial cable is a cost-effective way to connect workstations, personal computers, network servers, or low-end systems in an immediate area without any change in network performance. A single 185-meter (606-foot) segment can support up to 30 stations. Segments can be joined by repeaters or bridges.

### ▪ Unshielded Twisted-Pair

Unshielded twisted-pair wire—common telephone wire—can be used as an alternative to ThinWire to run Ethernet to the desk top.

Adapters connect a single Ethernet station or up to four daisy-chained workstations to the Ethernet using a *Digital Ethernet Multiport Repeater (DEMPR)*. (Daisy-chained systems are restricted to a total length of 10 meters.) One segment of unshielded twisted-pair wire can be 70 meters (230 feet) long. The adapters deliver 10 Mbits-per-second Ethernet performance.

Figure 6-8 shows how a Local Area Network joins computing equipment in a departmental environment, using both thickwire and ThinWire types of connections.

An Ethernet interface, both thickwire and ThinWire, is standard for Digital's workstations.

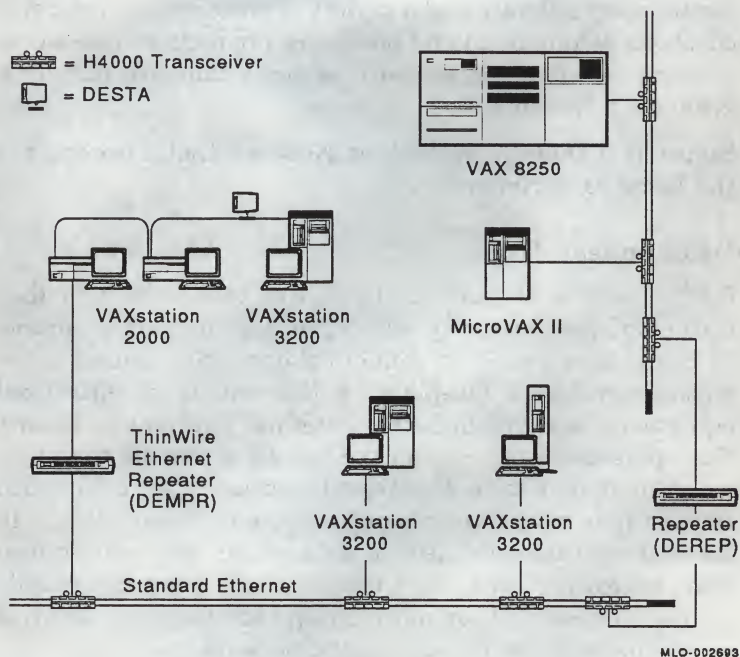


Figure 6-8 • Ethernet Local Area Network

## ▪ Wide Area Networks

A *Wide Area Network* is any network that crosses broad geographical boundaries, using long-distance communications. Nodes in such a network can be located many thousands of miles apart. Usually the network relies on common or public carriers, such as the telephone network, to transport messages over all or part of the distance.

Networking software and a variety of *synchronous* and *asynchronous* communications hardware products enable workstations to communicate with systems that are part of a Wide Area Network.

Figure 6-3 shows a Wide Area Network that encompasses the Local Area Network.

## ▪ DECconnect

*DECconnect* is Digital's cost-effective cabling system that accommodates virtually all office layouts, from simple to complex networking configurations. Specialized office wiring connects a faceplate on the wall to a centralized equipment area (called the Satellite Equipment Room). Four plug-in receptacles on the faceplate provide the physical connections for a ThinWire Ethernet cable, unshielded twisted-pair cable, telephone cable, and video cable. In turn, those cables connect to data, voice, and communications networks. With the wires in place, users can readily connect, disconnect, or move equipment from one location to another without disrupting the network.



## **Chapter 7 • Services**

Digital offers a range of services designed to meet customer needs. The services include innovative customer services and application resources that offer some of the best system and software solutions available today.

Digital's service programs are described briefly in this chapter. A sales representative can explain any service in more detail.

### **• Customer Service Organization**

To accommodate its diverse customer base, Digital has developed a broad portfolio of hardware, software, and training support. Service is delivered through the three branches of the Customer Service Organization: Field Service, Software Services, and Educational Services.

The service organization is backed by a half-billion dollar spare parts inventory and supports more than 40,000 professionals at 650 worldwide service locations. Service professionals are trained in total system support—hardware, software, networks, even other vendors' equipment—and receive continuous training to ensure that they are experienced in the latest service techniques and technologies.

### **• Field Service**

Field Service provides installation, warranty, and postwarranty support for Digital's hardware and software products. Field Service resources include vast parts inventories, a computerized logistics network, customer support centers, and technical specialists at the district, area, and headquarters levels.

The high reliability of the workstation family lets Digital offer comprehensive yet economical service products that provide customers excellent protection. Digital's expanded warranty and service offerings are unmatched in the industry for total system support.

• *General Warranty and Services*

Digital has enhanced its warranty service portfolio by introducing Expanded Warranty Support for the workstations. This expanded support allows customers flexibility in choosing the most appropriate level of service to meet specific business needs.

Under the new warranty program, workstation hardware and software system configurations feature a choice of Warranty Support Levels:

- BASIC, providing a fundamental level of support that will appeal to customers running noncritical applications.
- STANDARD, providing the recommended level of support that will satisfy the needs of the majority of customers.
- OPTIMUM, including higher levels of support for critical applications.

In addition to these levels of system warranty, a minimal level of warranty called Foundation Warranty is available. The Foundation Warranty, which customers may purchase for list price, provides a one-year Return-to-Digital warranty for parts only and a one-year conformance to Software Product Description.

Node Service is a competitively priced service offering customers an economical, yet comprehensive service solution. Digital can deliver this service at a cost saving because the call screening that is performed at the CPU is covered under System Service.

## ▪ **Software Services**

Software Services offers *Professional Consulting Services*, comprehensive support for Digital customers during any phase of system analysis, software development, or implementation. Professional Services provides the personal attention of a software consultant and continues for as long as the service is needed. The following services can be used throughout the solution lifecycle:

### ▪ *VAXstation Planning Services*

- Setting Long-term Workstation Direction
- Defining Information Strategy
- Planning Cost-Effective Networks
- Distributed Requirements
- Workstation Training for All User Levels

### ▪ *VAXstation Design Services*

- Integrating VAXstation Devices
- Local Area Network (LAN) Configuration Design
- Distributed Application Design
- DECwindows Application Design
- Workstation Plan Designs
- Custom Workstation Design

### ▪ *VAXstation Implementation Services*

- Integrating the Workstation to the Data Center
- Network Startup and Training
- Workstation Startup Service
- Distributed Application Implementation
- Desktop Application Support
- UNIX/Windowing Support and Training



- *VAXstation Management Services*

- Network Operational Support
- Distributed System Management
- Application Conversion Services
- VAXstation Application Support
- Low-Cost Workstation Multivendor Maintenance
- VAXstation Management Training

- *Enterprise Planning and Design Services*

Digital's Enterprise Planning and Design Services provide integrated management and information technology consulting. These consulting services help senior client management formulate high-level business, organization, and technology strategies, designs, and architectures.

Enterprise Planning and Design Services consist of modular and customizable components that help managers develop strategic plans that address business, human system, and technology success factors for individual strategic business units as well as for the entire enterprise.

- Strategic Planning Services—focuses on the full scope of the enterprise, translating and developing the business objectives and critical success factors into strategic action requirements, priorities, and plans.
- Strategic Design Services—the cross enterprise (or major business unit) analysis of critical business processes. These strategically focused services deal with the business, technical, and human components within each of the business processes. Also includes Enterprise Models that illustrate key organizational, information, and integration requirements.
- Information Architecture Services—the creation of information architectures is based on business, organization and integration requirements. Information architecture delivery includes development guidelines, strategies, and standards for cross-enterprise information management.

Also includes technology assessments, information analysis, detailed data flows, and recommendations for implementation.

- **Solution Architecture Services**—a cross-enterprise portfolio of strategic business applications and products to address the further development of implementation priorities and recommendations.
- **Program Management Capability**—enterprisewide programs that involve many products and vendors over a geographically dispersed area require a special degree of coordination and management. Digital offers sophisticated Program Management techniques to coordinate and manage the implementation of complex solutions for enterprisewide projects.

#### ▪ *Project Services*

Digital will design and manage solutions from application programs to complete systems and networks. An experienced project manager works with managers and the project team, from the problem analysis phase until the solution is completely operational, managing the integration of Digital and third-party components as required. Adherence to the Digital Product Methodology provides start-to-finish quality control; and the use of the right CASE (Computer Aided Software Engineering) tools ensures a high level of productivity and consistency.

#### ▪ *Consulting Services*

Consulting Services give customers access to Digital's software professionals. There are four families of Consulting Services: Management Services, Professional Consulting Services, Computer Operation Management Services, and Network Services.

- *Management Services*

Management Services provide leadership and management expertise for customer project, program, and system integration efforts.

- *Professional Consulting Services*

Professional Consulting Services include expertise in software engineering, application, and system design and programming; Artificial Intelligence Engineering; Strategic Consulting Services for assistance with particularly complex design or troubleshooting problems and support for mature products and technologies; Corporate Consulting; and Office Support Service.

- *Computer Operation Management Services*

Computer Operation Management Services provide experienced Digital computer professionals who plan system and VAXcluster configurations, manage resources for efficient operation, and offer guidance in computer center management.

- *Network Services*

Software Services provide a full range of network analysis, design, and development services as part of Digital's comprehensive Network Services portfolio.

- *Service Packages*

The following service packages are available:

- Startup Service Packages (SSPs) provide seamless, cross-functional, comprehensive service support for the software and training needs of the end users of Digital products. SSPs are defined sets of services essential to successful system installation, startup, and usage during the first year of operation.



Digital offers three comprehensive levels of Startup Service Packages (Level I, Level II, and Level III). Each SSP provides training (available immediately upon purchase), a DECstart Service, and initial media and documentation.

- **DECstart Services**

DECstart and DECstart PLUS services provide two levels of onsite startup consulting for a wide variety of operating systems, application products, VAXcluster systems, and networks. These services help reduce startup time and assure smooth system operation by quickly orienting employees to new features, functionality, and procedures. They are available alone or as a key component of Digital's more comprehensive Startup Service Packages.

- **Performance Services**

Performance Services evaluate your system's performance and help you adapt to system changes as well as find ways to increase user satisfaction. These services allow you to anticipate system performance problems, find solutions, and plan for future capacity requirements.

- **Security Services**

VMS Security Enhancement Services help safeguard users, data, and software from security threats. Security Services provide trained Digital consultants with packaged application software and documentation who devise a systemwide security policy to meet your specific needs. The VMS Security Review Service (VMS SRS) provides you an evaluation of existing security controls. VMS SRS uses specially developed software tools to evaluate existing system security. This service meets the needs of Digital's VMS customers for an evaluation of their existing security implementation and provides specific recommendations for improving it.

## ▪ Educational Services

Digital's Educational Services offer training to help users become more proficient quickly at using powerful workstation tools, including the DECwindows user interface and special graphics applications.

Digital provides one of the largest training organizations in the industry. Comprehensive curricula are available for Digital's operating systems, high-level computer languages, data management products, networking, and communications products. Digital can also train you to develop DECwindows applications that are compliant with the *XUI Style Guide* or the Compound Document architecture, described in Chapter 4.

Digital's training on specific solutions applications is as flexible, complete, and productive as the powerful desktop workstations themselves. Students choose from classroom lectures, labs, computer-based instructions, interactive video technology, self-paced print, or video-based courses and seminars at one of over 40 training centers throughout the world. More than 500 courses are taught in 12 languages.

Digital also has its own publishing house, Digital Press, which publishes computer-related books written by leading authorities and practitioners in the field.

## ▪ Application Solution Resources and Services

Digital offers the following resources and programs to help customers determine the best application solutions for their areas of interest: the Cooperative Marketing Program, Application Centers for Technology, and VAX Solution Systems.

## • **Cooperative Marketing Program**

The Cooperative Marketing Program offers customers the latest application solutions, using the industry's leading software products. Digital has formed joint marketing and selling relationships with many industry solution suppliers. This arrangement provides an easy path for customers who wish to use industry applications on Digital's systems.

The Cooperative Marketing Program includes Cooperative Marketing Partners (CMPs) and System Cooperative Marketing Partners (SCMPs) whose members are reliable companies that offer leadership products in many areas. Their offerings increase the number and variety of application solutions available to Digital's customers.

## • **Application Centers for Technology**

The Application Centers for Technology (ACTs), available worldwide, feature Digital's hardware and software products and services in simulated user environments, such as a computer-aided design area or an executive office. The ACTs provide technical and business experts who demonstrate products and who understand system and application features and requirements.

At an ACT, technical experts analyze a customer's computing needs and offer solutions that use the latest technologies. The ACTs can also demonstrate products available through the Cooperative Marketing Program.

New ACTs are opening continually. Some of the existing centers are located in Irvine, Atlanta, Chicago, Detroit, and Seattle; Ottawa, Toronto, and Calgary; Munich; Tokyo; and Hong Kong.



## • VAX Solution Systems

VAX Solution Systems comprise a growing family of advanced end-user systems that address application areas. Preconfigured systems are created around Local Area Network technologies for Digital's VMS, ULTRIX, and MS-DOS operating system environments. These technologies include Local Area VAXcluster Systems for VMS systems and the Network File System (NFS) for ULTRIX systems.

A VAX Solution System can be used in combination with or as the foundation for a more complex computing environment. Each configuration is assembled with the latest software, network, and systems technologies from Digital and Cooperative Marketing suppliers. Each system is tested to ensure reliability and support.

VAX Solution Systems address the following general environments: artificial intelligence, application systems development, engineering, laboratory research, manufacturing, office, publishing, and sales.

## Chapter 8 • Workstation Software Applications

This chapter will help you easily identify Digital's workstation software applications.

Many more applications are available for Digital products. Refer to the following publications for more information.

*VAX Software Source Book, Fifth Edition*

Order Number: ED 31744-46

*ULTRIX Software Source Book, Fourth Edition*

Order Number: ED 32029-43

### ▪ About This Chapter

This chapter contains approximately 275 applications that run on Digital's workstations.

The classifications of software, listed in this chapter and in the table of contents, are arranged alphabetically. Product titles are listed alphabetically within each classification. You can also consult the index to find a specific product, by company. Each application description is arranged in the following manner:

- **Application Classification:** The classification appears at the top of the page of the first application in each class. Subclasses are also listed.
- **Application Title:** The product name and its acronym when appropriate.
- **Vendor Name and Address:** The name and address of the supplier.
- **Description:** Describes the product's features and capabilities.
- **Source Language:** If available, this information provides the source language(s) for the product.

- **Price Range:** Unless otherwise indicated, the cost is expressed in U.S. dollars and is given as a range. The price depends on several factors, such as the size and number of computers on which the product is to run.
- **Contact Name:** The person at the vendor's company to contact for more information about the application, and the contact's telephone number.

The vendor's international distributor or sales office is listed in Appendix A.

For more information on specific applications mentioned in this guide, contact the product vendor.



## ▪ Artificial Intelligence Tools

### ▪ *IBUKI Common LISP™*

IBUKI

1447 North Shoreline Blvd.

Mountain View, CA 94043

IBUKI Common LISP is a complete implementation of common LISP including compiler, interpreter, symbolic debugging tools and X Window System interface. Especially appropriate for delivery of LISP-based systems.

*Source Language:* C and Common LISP

*Price Range:* \$1,400-\$5,200

*Contact:* Robert Brandt, (415) 961-4996

### ▪ *Mercury KBE™*

Artificial Intelligence Technologies, Inc.

40 Saw Mill River Road

Hawthorne, NY 10532

Mercury Knowledge Base Environment is a state-of-the-art tool for building intelligent integrated solutions, such as expert systems, which require extremely high performance, tight integration, database connectivity, persistent storage, ease of use and productivity. Mercury KBE allows the easy construction of large knowledge bases, tightly integrated with Digital's layered software products and general computing facilities.

*Source Language:* VAX LISP

*Price Range:* Available upon request

*Contact:* Anthony Cangemi, (914) 347-6860

## ▪ Automated Mapping

- *GIS/AMS (Geographic Information System/Advanced Mapping System)*

GeoVision Corporation

1600 Carling Ave.

Suite 350

Ottawa, CANADA K1Z8R7

GIS/AMS gathers and manages large volumes of multi-application, land-related information from diverse sources. It includes an embedded copy of a relational database management for managing attribute data.

*Source Language:* C, Xlib

*Price Range:* Available upon request

*Contact:* Deborah Reinert, (303) 796-8200

## ▪ Business Management—Planning

## ▪ Business Graphics

- *Visual:ProChart™*

Visual Engineering, Inc.

2150 North First Street

Suite 600

San Jose, CA 95131

Visual:ProChart features filled typefaces and extra-thick plot lines. Visual Engineering's implementation of the ANSI/ISO GKS Standard allows graphics to be generated on almost any graphics device.

*Source Language:* C

*Price Range:* \$2,000—\$16,000

*Contact:* David McMurdie, (408) 922-2800

- **Data—Information Management**

- **Fourth Generation Languages—Report Writers**

- **FOCUS**

Information Builders, Inc.  
1250 Broadway  
New York, NY 10001

FOCUS, a fourth generation language database management system, includes integrated decision support tools suitable for end users and MIS professionals. It has its own dictionary system and supports RMS files.

*Source Language:* C, FORTRAN, MACRO

*Price Range:* \$3,200–\$125,000

*Contact:* Jack Callahan, (212) 736-4433

- **DBMS—Integrated Database Management Systems**

- **ORACLE® Relational Data Base Management System**

Oracle Corporation  
20 Davis Drive  
Belmont, CA 94002

ORACLE networks and distributes databases. It features the SQL PLUS nonprocedural data language, an integrated data dictionary, an interactive screen facility, a report writer, and other application development tools.

*Price Range:* \$600–\$96,000

*Contact:* Doug Collins, (617) 862-7339



## ▪ **Decision Support Solution**

### ▪ *DECdecision™ V1.0*

Digital Equipment Corporation Inc.

146 Main Street

Maynard, MA 01754-2571

DECdecision is a decision support environment with three integrated components plus BUILDER, a tool that lets users "build" their own applications.

ACCESS: Provides remote and local access to distributed data.

CALC: Offers spreadsheet capabilities for "what if" scenarios.

CHART: Creates graphics to pictorially display your information.

BUILDER: A tool for users to record sequences of tasks as they perform them. Users then can play back, edit and share the application "blueprint."

*Source Language:* C

*Price Range:* \$1,000

*Contact:* Consult your local Digital Sales Office.

## ▪ **Document Processing**

### ▪ *DECwrite™ V1.0*

Digital Equipment Corporation Inc.

146 Main Street

Maynard, MA 01754-2571

DECwrite is a document processing application that runs in the DECwindows environment. DECwrite supports Digital's Compound Document Architecture with "Live Links." DECwrite includes charting, drawing, PostScript output and author aids such as spelling correction and usage alert.

*Source Language:* C

*Price Range:* \$1,500 per user. Volume pricing available.

*Contact:* Consult your local Digital Sales Office.

▪ **Engineering—General Engineering**

▪ **General Engineering Tools**

▪ **Alis®**

Applix, Inc.

112 Turnpike Road

Westborough, MA 01581

Alis is a technical office automation system that integrates text, graphics, spreadsheets, and database information to provide engineering specifications and technical reports. It is network-based and offers mail.

*Source Language:* C

*Price Range:* \$2,400–\$50,000

*Contact:* Tony Goschalk, (508) 870-0300

▪ **AutoDRAW™**

AI Systems

2450 East 7000 South

Salt Lake City, UT 84121

AutoDRAW, designed for architects and engineers, has four application-specific or symbol library overlays, and automatic adjustments for plotting scales, layering conventions, dimension toggles, and more.

*Source Language:* LISP

*Price Range:* \$695–\$10,000

*Contact:* Ken Coburn, (801) 942-8949

• **BLOX® TEMPLATE®**

Template Graphics Software, Inc.  
9685 Scranton Road  
San Diego, CA 92121

BLOX/TEMPLATE is a graphical UIMS that lets a programmer develop the user interface portion of an application without writing any code. The programmer can design or prototype interfaces interactively using a mouse.

*Source Language:* FORTRAN

*Price Range:* \$9,200–\$50,000

*Contact:* Kristy Benner, (619) 457-5359

• **CA-DISSPLA™**

Computer Associates International, Inc.  
Applications Products Division  
711 Stewart Avenue  
Garden City, NY 11530

CA-DISSPLA is a high-level subroutine plotting language that provides production tools for both business and scientific programmers. It can generate charts, maps, graphs, reports, contours, and 3D designs.

*Price Range:* \$3,600–\$22,000

• **DI-3000®**

Precision Visuals, Inc.  
6260 Lookout Road  
Boulder, CO 80301

This integrated set of device-independent graphics software tools includes over 230 FORTRAN subroutines. Features include modular design for networking, support for over 80 graphics devices, maps and drawings to scale, and more.

*Source Language:* FORTRAN

*Price Range:* \$4,000–\$30,000

*Contact:* Chris Logan, (303) 530-9000



- *DPA/G Single Line Diagrams (SLD)*

Scott & Scott Consultants  
2121 Fourth Avenue  
Suite 303  
Seattle, WA 98121

DPA/G SLD can produce single-line diagrams of one or more electrical distribution feeders included in the DPA/G database. Users can select the feeder to be plotted, the frame size or scale of drawing, and more.

*Source Language:* FORTRAN

*Price Range:* \$7,900–\$15,000

*Contact:* Annette M. Erley, (206) 441-1804

- *FIGARO™*

Template Graphics Software, Inc.  
9685 Scranton Road  
San Diego, CA 92121

FIGARO is a 2- and 3D graphics tool designed to support the new generation of graphics workstations and advanced graphics applications. It is a portable commercial implementation of the ANSI/ISO PHIGS standard.

*Source Language:* FORTRAN, C

*Price Range:* \$3,500–\$25,000

*Contact:* Kristy Benner, (619) 457-5359

- *GRAFkit™*

SCO, Inc.  
740C South Pierce Avenue  
Suite 15  
Louisville, CO 80027

GRAFkit is a technical graphics package composed of a Graphical Kernel System (GKS) foundation and high-level utilities. User-specified parameters include labeling, smoothing, scaling, and interpolating the data array.

*Source Language:* FORTRAN-77

*Price Range:* \$2,500-\$26,000

*Contact:* LaNell Svoboda, (303) 666-5400

▪ **MATLAB™**

The MathWorks, Inc.

21 Eliot Street

South Natick, MA 01760

MATLAB is an interactive software package for scientific and engineering applications. It combines numerical analysis, matrix computation, signal processing, graphics, and more. Optional add-on packages are available.

*Source Language:* C

*Price Range:* Available upon request

*Contact:* James Tung, (508) 653-1415

▪ **PIGS (PAFEC Interactive Graphics Suite)**

PAFEC, Inc.

6855 Jimmy Carter Boulevard

Suite L1200

Norcross, GA 30071

PIGS will add and delete nodes and elements; rotate, window, and zoom in on the mesh; display and change topology; plot deformed shape; list and change nodal coordinates; update PAFEC database, and more. Digitizing is optional.

*Source Language:* FORTRAN

*Price Range:* \$7,000-\$12,600

*Contact:* Joe Walsh, (404) 441-9300

▪ **Re:Vision™**

Impell Computer Systems

2201 Dwight Way

Berkeley, CA 94704

Re:Vision, an interactive graphics program, modifies and revises drawings captured from digital scanners. Features include pan and zoom viewing, various graphics objects, image modification, and text handling facilities.

*Source Language:* C

*Price Range:* \$7,500

*Contact:* Jerry A. Goedicke, (415) 549-9119

▪ **S-PLUS®**

Statistical Sciences, Inc.  
2825 Eastlake Avenue, East  
#106

P. O. Box 85625  
Seattle, WA 98145-1625

This interactive language and system for data analysis, graphics, statistics, and mathematical computing features exploratory data analysis; univariate, bivariate, and multivariate statistics; and regression methods.

*Source Language:* C, FORTRAN, RATFOR

*Price Range:* \$2,400-\$2,800

*Contact:* David A. Hartwell, (206) 322-8707

▪ **SciGraph™**

MGA, Inc.  
73 Junction Square Drive  
Concord, MA 01742

This statistical, 2D color graphics software for scientists and engineers lets users perform graphical analysis and present complex data relationships. It is self-teaching and permits access from other programs.

*Source Language:* FORTRAN

*Price Range:* \$2,500-\$14,000

*Contact:* John Rodrigues, (508) 369-5115



▪ *Tech Illustrator*

Auto-trol Technology Corporation  
12500 North Washington Street  
Denver, CO 80233

Tech Illustrator can draw in 2D, 3D, isometric, or perspective projections. It features user-definable macros and menus, graphics capture, CAD/CAM modification, interface with electronic publishing, and more.

*Source Language:* FORTRAN, C

*Price Range:* Available upon request

*Contact:* Robert McInroy, (303) 252-2133

▪ *TEMPLATE®*

Template Graphics Software, Inc.  
9685 Scranton Road  
San Diego, CA 92121

TEMPLATE is a set of graphics tools designed for 3D mechanical CAD, structure analysis, finite element analysis, and other scientific and engineering applications. It supports a wide range of display and plotting devices.

*Source Language:* FORTRAN

*Price Range:* \$3,200-\$80,000

*Contact:* Kristy Benner, (619) 457-5359

▪ **Engineering Management and Planning**

▪ *DESCTOP (Direct Executing Scientific Test and Operations Package)*

G. A. and T. M. Korn, Industrial Consultants  
6801 Opatas Street  
Tucson, AZ 85715

DESKTOP provides interactive simulation of dynamic systems for scientific and engineering workstations. It does variable, matrix, and vector calculations and has Fourier transform routines, programming statements, and more.

*Source Language:* Pascal

*Price Range:* \$360-\$3,600

*Contact:* G. A. Korn, (602) 298-7054

## ▪ CAD/CAM/CAE

### ▪ ANVIL-5000™

Manufacturing and Consulting Services, Inc.

6 Hughes

Irvine, CA 92718

ANVIL-5000 is CAD/CAM software that integrates surface and solid modeling, drafting analysis, numerical control, and management information reporting. Modules are OMNISOLIDS, OMNIFEM, 5-Axis Numerical Control Machining, and more.

*Source Language:* FORTRAN

*Price Range:* \$10,000-\$38,000

*Contact:* Bill Betts, (714) 951-8858

### ▪ ARC-DMS

ARC CADcentre Pty. Ltd.

361 Kent Street

Level 1

Sydney NSW 2000

Australia

ARC-DMS is an automated control and reporting document management system for CAD and non-CAD documents. Drawings are stored in a central database, and can be accessed by many users simultaneously.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* John K. Lancaster, (612) 290-2400

• **ARCAD® (Architectural Computer-Aided Design)**

International Graphics Engineering Systems, Inc.

P. O. Box 1590

Rancho Cucamonga, CA 91730

ARCAD, a 2D and 3D package for architectural, engineering, and construction industries and facilities management, produces drawings ranging from presentation schematics to working drawings and contract documents.

*Source Language:* FORTRAN

*Price Range:* \$10,000–\$25,000

*Contact:* Charles Maish, (714) 945-3327

• **AutoCAD® for VAXstation**

Digital Equipment Corporation

146 Main Street

Maynard, MA 01754-2571

AutoCAD for VAXstation is general-purpose design and drafting software that runs on most VAXstation computers. It allows interactive creating and editing of drawings of any size, features open architecture, and more.

*Price Range:* Available upon request

*Contact:* Consult your local Digital Sales Office.

• **BASEVIEW™**

Digital Equipment Corporation

146 Main Street

Maynard, MA 01754-2571



BASEVIEW is a CAD tool that reads and translates IGES, CALCOMP 960 Plot, and HP-GL Plot files for viewing on graphics terminals. Supports 3D drawing displays and the ability to pan, zoom, and rotate drawing information.

*Price Range:* Available upon request

*Contact:* Consult your local Digital Sales Office.

• **BOXER™**

PAFEC, Inc.

6855 Jimmy Carter Boulevard

Suite L1200

Norcross, GA 30071

BOXER is a modeler enabling users to construct informationally complete three-dimensional structures. The system assists in solving problems concerned with volume, mass, and three-dimensional shapes.

*Source Language:* FORTRAN

*Price Range:* \$10,000-\$24,000

*Contact:* Tony Christian, (404) 441-9300

• **Bravo3® BravoDRAFT™**

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986

BravoDRAFT is a detail drafting package that can operate standalone or integrated with the Bravo3 family of CAD/CAM products. It lets users produce drawings that conform to ANSI, ISO, DIN, and military specifications.

*Source Language:* Pascal

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

▪ **Bravo3® Design Review™**

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

Design Review lets users zoom, pan, and save various views of the part geometry and transfer drawings electronically. The menu format and online help for each command let any level of user access engineering drawings.

*Source Language:* Pascal

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

▪ **Bravo3® REDLINE™**

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

REDLINE allows users to view an existing drawing, add descriptive notes or geometry, and mark this geometry in red to clarify comments. The part geometry itself cannot be changed during this process.

*Source Language:* Pascal

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

▪ **Bravo3 Editor**

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

This editor consists of a 3D wireframe modeler, a drafter, and a data manager. A graphics language tool lets users create their own commands, write programs, and modify the system to suit their needs.

*Source Language:* PL/1

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

▪ *Bravo3 GRAFEM/IFAD*

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986

GRAFEM/IFAD is a package for creating, editing, checking, and viewing finite element models; performing finite element analysis; and displaying analysis results. It can detect stresses, strains, and more.

*Source Language:* PL/1

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

▪ *Bravo3 Solids Modeling*

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986

This software generates geometrically complete three-dimensional solid models for parts and assemblies using combination intersection or subtraction operations between solid features, parts, and assemblies.

*Source Language:* PL/1

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718



• *Bravo3 Surface Modeling*

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

This product lets the user create analytic and freeform warped surfaces. It features intersection between surfaces, filleting an intersection, cross point of a curve and a surface, and more.

*Source Language:* PL/1

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

• *CAM-X*

Ferranti Infographics Ltd.  
Bell Square  
Brucefield  
Livingston  
West Lothian EH54 9BY  
Scotland, United Kingdom

CAM-X introduces flexibility through user extension libraries containing FORTRAN-executable subroutines for graphics and data management operations. These programs function like other CAM-X applications.

*Source Language:* C

*Price Range:* Available upon request

*Contact:* J. D. Paton, 44 506 411583

• *CIS Medusa™*

CIS Medusa, Inc.  
201 Burlington Road  
Bedford, MA 01730

CIS Medusa is a CAD/CAM system incorporating 2D drafting and design with a solid modeler. A 3D design module allows users to construct 3D solid models from geometry contained in 2D drawings. A DBMS is also included.

*Source Language:* FORTRAN, C

*Price Range:* Available upon request

*Contact:* Leslie Feldman, (617) 276-1288

• *DOGS (Design-Oriented Graphics System)*

PAFEC, Inc.

6855 Jimmy Carter Boulevard

Suite L1200

Norcross, GA 30071

DOGS, a computer-aided design and drafting package, produces high-quality technical drawings for a variety of disciplines, including drawing layout, drawing, units, layering, dimension, and copying.

*Source Language:* FORTRAN

*Price Range:* \$14,000-\$45,000

*Contact:* Tony Christian, (404) 441-9300

• *DUCT™ (Design Using Computer Techniques)*

Deltacam Systems Ltd.

Aston Science Park

Birmingham B7 4AP

England, United Kingdom

DUCT is a surface modeler for the design and manufacture of complex objects, particularly those with double-curved surfaces, such as plastic moldings and metal castings or forgings.

*Source Language:* FORTRAN-77

*Price Range:* £14,000-£50,000

*Contact:* Glyn Evans, 44 21 3593659

- *EDGE Product Family*

Cadence Design Systems, Inc.  
555 River Oaks Parkway  
San Jose, CA 95134

EDGE Product Family is a complete set of tools for the design of complex integrated circuits. The tools are integrated into a Design Framework based upon a unified database, common user interface, and programming language.

*Price Range:* Available upon request  
*Contact:* Gary Lambert, (408) 943-1234

- *ERMS (Engineering Revision Management System)*

Digital Software Services  
Digital Equipment Corporation  
40 Old Bolton Road  
Stow, MA 01775

ERMS provides integrated software for a document management system. It provides electronic control, revision, and review of engineering drawings. It includes a user interface, an image translator, and display manipulation.

*Price Range:* \$25,000  
*Contact:* Consult your local Digital Sales Office.

- *EUCLID®-IS*

Matra Datavision, Inc.  
Rue de la Terre-de-Feu  
BP246 Z.A. de Courtaboeuf  
91944 Les Ulis  
France

EUCLID-IS is a solid-based CAE/CAD/CAM system that combines different modeling techniques to produce engineering models. It can define and edit solids and surfaces with the precision required for machining.



*Source Language:* FORTRAN

*Price Range:* \$30,000

*Contact:* Philippe Dalmas, 33 1 64466465

- *GDS (Graphics Design System)*

McDonnell Douglas Built Environment Technologies

11330 Olive Street

Suite 220

St. Louis, MO 63141

This interactive graphics program models and produces 2D drawings. Features include window definition, graphical input and editing, menu creation, data output, object and block editing, and line style definitions.

*Source Language:* C, Pascal, FORTRAN

*Price Range:* \$5,000

*Contact:* Kathleen Purcell, (314) 872-3122

- *HARDES®*

Expert Software Systems NV

Moutstraat 100

B-9000 Ghent

Belgium

HARDES is an electronic hardware CAE system for designing and testing ICs, PCBs, and digital systems. Its three main components are design entry, analysis, and transfer.

*Source Language:* ISO-Pascal

*Price Range:* \$6,000-\$60,000

*Contact:* Joost Cardoen, 32 91 210383

- *I-DEAS™ (Integrated Design Engineering and Analysis System)*

SDRC, Inc.

2000 Eastman Drive

Milford, OH 45150

I-DEAS is a mechanical computer-aided engineering (MCAE) system that provides design engineers with capabilities for design, analysis, drafting, and testing. Eight modules share a common database and user interface.

*Source Language:* FORTRAN, C

*Price Range:* \$8,300–\$108,000

*Contact:* Rick Skowronek, (513) 576-2400

• **InfoCAD**

Ferranti Infographics Ltd.

Bell Square

Brucefield

Livingston

West Lothian EH54 9BY

Scotland, United Kingdom

InfoCAD uses interactive graphics techniques to provide drafting productivity. It includes online help, a viewport capability, and an interface that is common with other CAM-X applications.

*Source Language:* C

*Price Range:* Available upon request

*Contact:* J. D. Paton, 44 506 411583

• **InfoSOLID**

Ferranti Infographics Ltd.

Bell Square

Brucefield

Livingston

West Lothian EH54 9BY

Scotland, United Kingdom

InfoSOLID is a solid modeler that uses InfoCAD facilities to provide sectioning, general intersections, visualization, and interference checking. It calculates surface area, volume, center of gravity, mass, and more.

*Source Language:* C  
*Price Range:* Available upon request  
*Contact:* J. D. Paton, 44 506 411583

• *InfoSURF*

Ferranti Infographics Ltd.  
 Bell Square  
 Brucefield  
 Livingston  
 West Lothian EH54 9BY  
 Scotland, United Kingdom

InfoSURF is a sculptured surface modeler that offers many ways of defining and modifying doubly curved surfaces. It provides several line drawing styles and shaded picture facilities and interfaces with InfoCAM.

*Source Language:* C  
*Price Range:* Available upon request  
*Contact:* J. D. Paton, 44 506 411583

• *Mesh Surfpac*

Numerical Control Computer Sciences  
 17321 Murphy Avenue  
 Irvine, CA 92714

Mesh Surfpac allows Northrop and McDonnell Douglas to download 3D mesh surfaces directly from their CAD database into an NCL database. Mesh surfaces can then be machined in a 3- through 5-axis mode.

*Source Language:* FORTRAN, C  
*Price Range:* Available upon request  
*Contact:* Ernest Dias D'Leon, (714) 474-7444



• **OIR MultiTree™ II Classification and Retrieval System**

OIR/Organization for Industrial Research  
100 Crosby Drive  
Bedford, MA 01730

This product identifies and retrieves existing designs in CAD databases that are identical or similar to new parts in design. Users can retrieve these designs by keyword, function, part, and code numbers.

*Source Language:* FORTRAN

*Price Range:* \$42,000–\$132,000

*Contact:* Richard G. Franzosa, (617) 275-1800

• **OPTIMATE™**

Optima Technology, Inc.  
900 Middlesex Turnpike  
Building 5  
Billerica, MA 01821

OPTIMATE, a CAD system for printed circuit boards, offers schematic capture, automatic placement, and automatic routing. Up to 1,000 components can be placed on a board and adjusted as needed.

*Source Language:* FORTRAN-77, C

*Price Range:* \$40,000–\$55,000

*Contact:* Robert Cowan, (508) 667-7877

• **PALETTE®**

Palette Systems, Inc.  
6 Trafalgar Square  
Nashua, NH 03063

PALETTE provides a central graphic database, interactive drafting and editing, interfaces to third-party systems, and a set of high-level programming tools allowing special-purpose programming and integration.

*Source Language:* FORTRAN

*Price Range:* \$5,000

*Contact:* Maryellen Horsley, (603) 886-1230

▪ *Prism/DDM™*

GE Calma

501 Sycamore Drive

Milpitas, CA 95035

Prism/DDM is mechanical CAE/CAD/CAM software that supports product development from concept to manufacturing through the use of solids modeling, wire frame, surfaces, finite element analysis, NC part programming, and more.

*Source Language:* FORTRAN-77

*Price Range:* \$4,550-\$75,000

*Contact:* George LeBlanc, (617) 890-8121

▪ *Pro/ENGINEER™*

Parametric Technology Corporation

128 Technology Drive

Waltham, MA 02154

Pro/ENGINEER is a parametric, feature-based, solid modeling system for mechanical engineering. It supports interactive design modifications to solid models of parts and assemblies, including tooling and features.

*Source Language:* C

*Price Range:* \$9,500

*Contact:* Harold S. Rhodes, (617) 894-7111

▪ *RUPLAN® (Rechner-Unterstützte PLANerstellung)*

AEG Software-Technik

Hohenzollerndamm 150

D-1000 Berlin

West Germany

RUPLAN is an interactive CAD system that processes circuit diagrams and all other types of connection diagrams and schematic drawings. It may also be used in measurement and control engineering, process engineering, and more.

*Source Language:* FORTRAN

*Price Range:* DM35.000

*Contact:* Mr. Hillman, 49 30 8282274

• *Series 7000*

Auto-trol Technology Corporation  
12500 North Washington Street  
Denver, CO 80233

Series 7000 is a mechanical product development tool that provides an integrated database for geometric modeling, analysis, detailing, documentation, and manufacturing. Models can be displayed, rotated, and examined.

*Source Language:* FORTRAN, C

*Price Range:* Available upon request

*Contact:* Robert McInroy, (303) 252-2133

• *UNIGRAPHICS®*

McDonnell Douglas Mfg. & Eng. Systems Company  
325 McDonnell Boulevard  
Dept. C235  
St. Louis, MO 63042

UNIGRAPHICS is a CAD/CAM tool for computer-assisted transition from conceptual product design to finished product and for utilizing advanced methods of NC part program generation and tool path verification.

*Source Language:* C, FORTRAN, Pascal

*Price Range:* \$20,000

*Contact:* Richard J. Rothfuss, (314) 232-3890



- **Workview™**

Viewlogic Systems Inc.  
313 Boston Post Road West  
Marlboro, MA 01752

Workview offers a suite of CAE tools from a full analog product, complete support for the systems designer, ASIC design kits, a mixed-mode analog/digital simulator, communications, and networking solutions. Workview's open architecture environment eases integration into existing CAE/CAD systems, supporting EDIF, VHDL, programmable access to database, and configurable user interfaces.

*Source Language:* C

*Price Range:* Available upon request

*Contact:* Chuck Deeg, (508) 480-0881

- **Process Design and Simulation**

- *PEGS (Project Engineering and Graphics System)*

CADCentre Ltd.  
High Cross  
Madingley Road  
Cambridge CB3 0HB  
England, United Kingdom

PEGS is an information and graphics management system specifically designed for the process industry. It enables the creation of schematics such as process flow, piping and instrument, and instrument loop diagrams.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Tom Brown, (713) 977-1225

## ▪ Structural Engineering—Stress Analysis

### ▪ ANSYS®

Swanson Analysis Systems, Inc.

Johnson Road

P. O. Box 65

Houston, PA 15342-0065

ANSYS, a finite element tool for engineering analysis, solves mechanical, thermal, and electronic problems. Results are expressed as displacements, magnetic fields, stresses, strains, temperatures, and velocity vectors.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Carol A. Evans, (412) 746-3304

### ▪ CAPS

Concept Analysis Corporation

14789 Keel Street

Plymouth, MI 48170

CAPS calculates area, inertia, centroid, resistance, and other section properties of arbitrary cross sections and open and closed sections. CAPS can use data from a digitizing tablet and create a plot or file as output.

*Source Language:* FORTRAN-77

*Price Range:* \$4,800

*Contact:* Fred Sheill, (313) 455-2340

### ▪ CDIG

Concept Analysis Corporation

14789 Keel Street

Plymouth, MI 48170

CDIG, a graphics driver used to digitize grid points and output the data in finite element format, permits digitizing in two views and merges the data in a 3D format. It uses PLOT 10 graphics protocol.

*Source Language:* FORTRAN-77

*Price Range:* \$4,800

*Contact:* Fred Sheill, (313) 455-2340

▪ *Concept*

Concept Analysis Corporation

14789 Keel Street

Plymouth, MI 48170

This finite element analysis program analyzes ceramics, composites, and plastic structures. It features differentiation between tension and compression modulus capability and runs force, pressure, and thermal loads.

*Source Language:* FORTRAN-77

*Price Range:* \$32,000

*Contact:* Fred Sheill, (313) 455-2340

▪ *COSMOS™*

Structural Research & Analysis Corporation

1661 Lincoln Boulevard

Suite 100

Santa Monica, CA 90404

COSMOS, a linear and nonlinear finite element program consisting of a pre- and postprocessor, performs structural, fluid, thermal, nonlinear, and electrical network analyses in color graphics.

*Source Language:* FORTRAN-77

*Price Range:* \$10,000–\$33,000

*Contact:* Ali Sarhangnezhad, (213) 452-2158



• *CPOST*

Concept Analysis Corporation  
4789 Keel Street  
Plymouth, MI 48170

CPOST, a postprocessing plotter, plots contour deflections and stresses. Deflections in the X, Y, and Z directions can be plotted, as well as total magnitudes (vectors), shear stress, and Von Mises stress contours.

*Source Language:* FORTRAN-77

*Price Range:* \$8,000

*Contact:* Fred Sheill, (313) 455-2340

• *DAST™ (Design and Analysis of Structures)*

Das Consulting, Inc.  
104 Blueberry Hill  
North Andover, MA 01845

DAST performs linear static analysis of elastic structural systems and designs steel structures. It offers a large library of elements that can be used for analysis and supports standard and user-specified steel sections.

*Source Language:* FORTRAN-77, C, Assembler

*Price Range:* \$1,400-\$10,000

*Contact:* Dr. Mukti L. Das, (508) 794-1487

• *Fatigue DATS*

Prosig Computer Consultants Ltd.  
Link House  
High Street  
Fareham  
Hants PO16 7BQ  
England, United Kingdom

This product provides a menu-driven environment and a set of tools for engineers and scientists engaged in the analysis

and graphical presentation of experimental and theoretical data in fatigue analysis.

*Source Language:* FORTRAN-77

*Price Range:* £3,870-£6,220

*Contact:* R. F. Hinson, 44 329 239925

• **GTSTRUDL®**

Georgia Tech Research Corporation

GTICES Systems Laboratory

Georgia Institute of

Technology

Atlanta, GA 30332-0355

GTSTRUDL assists engineers in the structural analysis and design process. This package integrates structural and finite element analysis, design, graphic display, and structural database management features.

*Source Language:* C, ICETAN, FORTRAN

*Price Range:* \$2,200-\$80,000

*Contact:* Michael T. Lee, (404) 894-2260

• **GTSTRUDL-Prep**

Georgia Tech Research Corporation

GTICES Systems Laboratory

Georgia Institute of Technology

Atlanta, GA 30332-0355

GTSTRUDL-Prep is an interactive menu system for generating input files for GTSTRUDL. It allows engineers to create syntactically correct GTSTRUDL commands. Disk files can be processed in batch or interactive modes.

*Source Language:* C

*Price Range:* \$95-\$195

*Contact:* Michael T. Lee, (404) 894-2260

- *MARC™ General Purpose Finite Element Program*

MARC Analysis Research Corporation  
260 Sheridan Avenue  
Suite 309  
Palo Alto, CA 94306

MARC performs linear and nonlinear analysis for large strain and displacement problems. It provides four libraries of routines that address a wide range of analysis problems.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Anna K. Fijewski, (415) 326-7511

- *MENTAT™ Interactive Graphics*

MARC Analysis Research Corporation  
260 Sheridan Avenue  
Suite 309  
Palo Alto, CA 94306

MENTAT is a general-purpose, interactive pre- and postprocessor for finite element analysis programs. It develops and verifies models, displays them graphically, and integrates with several finite element programs.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Henry Fong, (415) 326-7511

- *PAFEC (Programs for Automatic Finite Element Calculations)*

PAFEC, Inc.  
6855 Jimmy Carter Boulevard  
Suite L1200  
Norcross, GA 30071



PAFEC performs elastic static analysis, modes and frequencies analysis, heat transfer, nonlinear analysis, direct integration response, direct frequency response, substructures, and lubrication-structure interaction.

*Source Language:* FORTRAN

*Price Range:* \$18,000-\$35,000

*Contact:* Joe Walsh, (404) 441-9300

▪ *SES (Structural Engineering Series)*

ECOM Associates, Inc.

8634 West Brown Deer Road

Milwaukee, WI 53224

SES is a library of programs designed for the structural engineer. Features include terminal independence, centralized database, program-to-program data flow, and menu-driven input.

*Source Language:* C

*Price Range:* \$300-\$10,000

*Contact:* David Buettner, (414) 354-0243

▪ *STRUDL (STRUctural Design Language)*

MBB, Datenverarbeitung u. Ablauforganisation

Abt. LWD 10

MBB

POB 801160

8000 Munchen

Federal Republic of Germany

STRUDL is a program for the design of structures using the finite element method and for the display of models and computational results. It performs many analyses, for example, stiffness, dynamic, heat, beam, flow, network, and more.

*Source Language:* FORTRAN-77

*Price Range:* DM15.000-DM25.000

*Contact:* Georg Papadopoulos, 49 89 60008374

• **SYSNOISE**

Dynamic Engineering

Ambachtenlaan 21

Heverlee

Belgium

SYSNOISE is tailored to the numerical modeling of acoustic fields in one, two, and three dimensions, using finite element and boundary element methods. It calculates natural frequencies, modes, response to excitation, and more.

*Source Language:* FORTRAN-77

*Price Range:* fr.500.000-fr.3.000.000

*Contact:* Wynendaele Hans, 32 16 221389

• **SYSTUS®**

Framatome Structural Analysis Division

Tour Fiat

Cedex 16

F-92084 Paris

France

SYSTUS, a finite element structural analysis system that performs linear/nonlinear, static/dynamic analysis of heat transfer and thermo-mechanical problems, is used by engineers in industrial environments.

*Source Language:* FORTRAN

*Price Range:* \$350-\$2,000

*Contact:* Pierre Bougrelle, 33 1 85963276

## ▪ Engineering—Specialized Applications

### ▪ Civil Engineering—Construction

#### ▪ ARC COGO

Environmental Systems Research Institute, Inc.  
380 New York Street  
Redlands, CA 92373

ARC COGO tools support land surveyors and civil engineers in design and mapping applications such as layouts of subdivisions, roads, and related facilities. Data in the ARC/INFO database may be used with ARC COGO.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* S. J. Camarata, (714) 793-2853

#### ▪ ARC-NET (Telco)

ARC CADcentre Pty. Ltd.  
361 Kent Street  
Level 1  
Sydney NSW 2000  
Australia

ARC-NET provides graphical network management facilities by modeling multicore cable and optical fiber networks. It displays the networks graphically over a landbase map. Editing functions are provided.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* John K. Lancaster, 61 2 2902400



- *ARC-TLD*

ARC CADcentre Pty. Ltd.  
361 Kent Street  
Level 1  
Sydney NSW 2000  
Australia

ARC-TLD is a software engineering tool for the global optimization of transmission line design and tower placement. It optimizes over an unlimited terrain area and allows designs to be modified interactively.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* John K. Lancaster, 61 2 2902400

- *CEAL® (Civil Engineering Automation Library)*

CLM/Systems, Inc.  
4023 South Dale Mabry  
Tampa, FL 33611

CEAL is an integrated set of programs designed for surveying and mapping; site and civil engineering; transportation and highway design; and plan, profile, and cross-section drafting. The programs have a common database.

*Source Language:* FORTRAN

*Price Range:* \$15,000–\$48,000

*Contact:* C. L. Miller, (813) 831-7090

- *CMED (Computerized Mapping and Engineering Data)*

Scott & Scott Consultants  
2121 Fourth Avenue  
Suite 303  
Seattle, WA 98121

CMED is a mapping and engineering system that combines engineering data entry with CAD capabilities to build a computerized distribution map system and a distribution engineering database. It has drawing and mapping menus.

*Source Language:* FORTRAN

*Price Range:* \$15,900-\$41,000

*Contact:* Annette M. Erley, (206) 441-1804

• *Dimension III™*

GE Calma

501 Sycamore Drive

Milpitas, CA 95035

This product is an integrated, 3D design and engineering system. The core modules support 2D and 3D design, engineering analysis, interference detection, drawing creation, and bill of materials extraction.

*Source Language:* FORTRAN-77

*Price Range:* \$4,550-\$75,000

*Contact:* George LeBlanc, (617) 890-8121

• *INFORMAP III™*

Synercom Technology, Inc.

2500 City West Boulevard

Suite 1100

Houston, TX 77042

INFORMAP III is a mapping database software system that combines a georelational database with interactive graphics and mapping techniques in a single, integrated software package.

*Source Language:* FORTRAN

*Price Range:* \$7,500-\$60,000

*Contact:* Jo Ann DeAngelis, (713) 954-7000

- *KDMS (Kork Digital Mapping System)*

Kork Systems, Inc.  
6 State Street  
Bangor, ME 04401

KDMS is an interactive digital mapping and database management system that creates a standardized database from existing maps and stereomodels for scientific, engineering, and photogrammatic applications.

*Source Language:* Pascal, C, MACRO assembler, FORTRAN-77

*Price Range:* \$60,000–\$120,000

*Contact:* Alice Corbett, (207) 945-6353

- *Kern INFOCAM Geo-Information*

Survey & General Instrument Co. Ltd.  
Fircroft Way  
Edenbridge  
Kent TN8 6HA, United Kingdom

This geographical information system accepts surveying or photogrammetric measurements, digitized maps, or alphanumeric attributes as input. Output may be graphics screen or dump, printed reports, or pen plots.

*Source Language:* FORTRAN-77

*Price Range:* £13,000–£90,000

*Contact:* Dr. A. S. Walker, 44 732 864111

- *KGIS (Kork Geographic Information System)*

Kork Systems, Inc.  
6 State Street  
Bangor, ME 04401

KGIS is a geographic database management system that supports graphical and textual queries, transactions, and analysis. It includes cartographic, topologic, and geographic views of the world.



*Source Language:* C, Pascal, FORTRAN-77

*Price Range:* \$100,000-\$200,000

*Contact:* Alice Corbett, (207) 945-6353

▪ *MPDS (Medusa Plant Design System)*

Computervision Medusa

Harston Mill

Royston Road

Harston

Cambridge CB2 5NL

England, United Kingdom

MPDS covers all project phases, from conceptual design to commissioning and operation, for projects of any size. Features include P&ID drafting, unrestricted shape definition, interactive pipe routing and steelwork, and more.

*Source Language:* FORTRAN, C, BASIC II

*Price Range:* £24,000

*Contact:* Hilary Jarvis, 44 223 871717

▪ *NETWORK<sup>TM</sup>*

Environmental Systems Research Institute, Inc.

380 New York Street

Redlands, CA 92373

NETWORK creates, analyzes, and displays geographic networks such as city streets, rivers, railroads, and utility lines. It allows users to simulate operations that occur in real networks, including allocating and routing.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* S. J. Camarata, (714) 793-2853

▪ **PLAN™**

Decision Graphics, Inc.  
200 Friberg Parkway  
Two Westborough Business Park  
Westborough, MA 01581

PLAN is a schematic planning package for building layout and equipment planning. It operates in an interactive mode with a graphics screen and cursor. It can be used with metric or English units, at any scale.

*Source Language:* FORTRAN

*Price Range:* \$6,400

*Contact:* Gary Wuenn, (508) 870-5900

▪ **Series 5000**

Auto-trol Technology Corporation  
12500 North Washington Street  
Denver, CO 80233

Series 5000, designed for industrial facilities engineering and design, provides 3D geometry, random access with an in-place updating capability, user-definable units, and single- or double-precision data representation.

*Source Language:* FORTRAN, C

*Price Range:* Available upon request

*Contact:* Robert McInroy, (303) 252-2133

▪ **TWODEE™**

Decision Graphics, Inc.  
200 Friberg Parkway  
Two Westborough Business Park  
Westborough, MA 01581

TWODEE is a general-purpose design/drafting program using graphics workstations. It was designed for facility planning, but has been used for architectural design and drafting, electrical and HVAC drafting, and more.

*Source Language:* FORTRAN

*Price Range:* \$6,400

*Contact:* Gary Wuenn, (508) 870-5900

▪ **Earth Resource Engineering—Mining Engineering**

▪ **B-MAP™**

Zycor, Inc.

220 Foremost Drive

Austin, TX 78745

B-MAP produces annotated basemaps containing posted shotpoint and well locations, land grid networks, geomorphic and cultural data, lat/long borders, title blocks, bar scales, and direction arrows.

*Source Language:* FORTRAN

*Price Range:* \$7,500–\$100,000

*Contact:* Mark Franke, (512) 282-6699

▪ **Balanced Section Package**

Midland Valley Exploration Ltd.

14 Park Circus

Glasgow G3 6AX

Scotland, United Kingdom

This package allows modeling of complex geological structures and provides the necessary tools to check the geometrical validity of existing interpretations.

*Source Language:* FORTRAN-77

*Price Range:* £15,000–£100,000

*Contact:* Dr. John Wheeler, 44 41 3322681



- *Contouring System*

Precision Visuals, Inc.  
6260 Lookout Road  
Boulder, CO 80301

This system is a collection of routines that provide 3D mesh grid generation and contour mapping capabilities. It allows generation of contour maps from gridded or random data, control of map characteristics, and more.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Chris Logan, (303) 530-9000

- *EMIS™ (Environmental Mapping Information System)*

Synercom Technology, Inc.  
2500 City West Boulevard  
Suite 1100  
Houston, TX 77042

EMIS is an integrated geographic information system that provides information processing for natural resource agencies, government organizations, telephone companies, and utilities.

*Source Language:* FORTRAN

*Price Range:* \$2,500-\$12,000

*Contact:* Jo Ann DeAngelis, (713) 954-7000

- *ISM™ (Interactive Surface Modeling)*

Dynamic Graphics, Inc.  
2855 Telegraph Avenue  
Suite 405  
Berkeley, CA 94705

ISM performs mapping and analysis functions for the exploration of oil, gas, coal, and other natural resource activities. This menu-driven system is used to create models from geologic, geophysical, and terrain data.

*Source Language:* FORTRAN

*Price Range:* \$24,000-\$100,000

*Contact:* (403) 264-2525

• **MIMIC™**

Sierra Geophysics, Inc.

11255 Kirkland Way

Kirkland, WA 98033

MIMIC provides definition and editing of seismic reflectors or layer boundaries, compilation of horizons into three-dimensional models, and examination and verification of horizons and models using color graphics.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Gary M. Lundquist, (206) 822-5200

• **PSA5 (Pipe Stress Analysis)**

Whessoe Technical & Computing Systems Ltd.

Brinkburn Road

Darlington DL3 6DS

United Kingdom

PSA5 is an analysis tool for the static and/or dynamic analysis of any pipework system and can analyze any pipework system subjected to thermal, gravitational, wind, and pressure loading.

*Source Language:* FORTRAN

*Price Range:* £10,000-£40,000

*Contact:* Malcom J. Egglestone, 44 325 381818

• **QUIKCDP™**

Sierra Geophysics, Inc.

11255 Kirkland Way

Kirkland, WA 98033

QUIKCDP, a three-dimensional raytracing program, is general in terms of seismic-field configuration and types of raypaths. Straight seismic, dogleg, and arbitrarily curved lines and full 3D shoots are supported.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Gary M. Lundquist, (206) 822-5200

• QUIKDIG™

Sierra Geophysics, Inc.

11255 Kirkland Way

Kirkland, WA 98033

QUIKDIG digitizes contour maps for gridding and creates 2D geologic models from cross sections. It generates group and shotpoint location files and combines information for automatic map posting.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Gary M. Lundquist, (206) 822-5200

• QUIKLOG™

Sierra Geophysics, Inc.

11255 Kirkland Way

Kirkland, WA 98033

QUIKLOG in log entry mode supports interpolation, smoothing, editing, stretching, and tying of multiple log types for a well. In seismic mode it produces montage displays of logs and apparent 2D seismic lines.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Gary M. Lundquist, (206) 822-5200



- **QUIKRAY®**

Sierra Geophysics, Inc.  
11255 Kirkland Way  
Kirkland, WA 98033

QUIKRAY simulates stacked seismic sections by performing 3D raytracing in either normal-incidence mode or image-ray mode for sections before or after time migration.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Gary M. Lundquist, (206) 822-5200

- **QUIKSHOT® / QUIKVSP™**

Sierra Geophysics, Inc.  
11255 Kirkland Way  
Kirkland, WA 98033

QUIKSHOT performs 3D abnormal incidence raytracing to simulate shot records. QUIKVSP performs 3D abnormal incidence raytracing to simulate offset and vertical seismic profiling VSP.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Gary M. Lundquist, (206) 822-5200

- **RAYMAP®**

Sierra Geophysics, Inc.  
11255 Kirkland Way  
Kirkland, WA 98033

RAYMAP provides a three-dimensional method for depth conversion starting with interpreted time maps and then using 3D raytracing to determine a new depth contour map.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Gary M. Lundquist, (206) 822-5200

▪ **RESIN™**

Zycor, Inc.  
220 Foremost Drive  
Austin, TX 78745

RESIN produces initialization matrix data for reservoir simulators from Z-MAP contours. Through the use of interactive graphics, it constructs simulator grids and computes matrix values from each contour map.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Mark Franke, (512) 282-6699

▪ **SDL™ (Surface Display Library)**

Dynamic Graphics, Inc.  
2855 Telegraph Avenue  
Suite 405  
Berkeley, CA 94705

SDL is a library of FORTRAN subroutines used by geophysical and geologic firms and others to produce mapping-quality graphical displays from gridded X-Y-Z data. A user can annotate displays with mapping information.

*Source Language:* FORTRAN

*Price Range:* \$12,000–\$35,000

*Contact:* (403) 264-2525

▪ **SGL™ (Surface Gridding Library)**

Dynamic Graphics, Inc.  
2855 Telegraph Avenue  
Suite 405  
Berkeley, CA 94705

This library of FORTRAN subroutines uses scattered data points to produce mathematical models of surfaces of least tension and curvature for terrain analysis and mapping. Used with SDL, it creates maps and perspectives.

*Source Language:* FORTRAN

*Price Range:* \$12,000-\$35,000

*Contact:* (403) 264-2525

▪ *SLP™ (Seismic Line Program)*

Dynamic Graphics, Inc.

2855 Telegraph Avenue

Suite 405

Berkeley, CA 94705

SLP uses seismic section and line location (basemap) input data in an interactive format for surface model grid calculations. It also offers data editing, file management, and seismic processing output capabilities.

*Source Language:* FORTRAN

*Price Range:* \$12,000-\$35,000

*Contact:* (403) 264-2525

▪ *STRATVIEW™*

Zycor, Inc.

220 Foremost Drive

Austin, TX 78745

STRATVIEW displays, manipulates, and correlates well logs and lithology from well to well. It provides tools for shifting, flattening, combining, and editing log or lithology data.

*Source Language:* FORTRAN

*Price Range:* \$15,000-\$100,000

*Contact:* Mark Franke, (512) 282-6699

▪ *TIN™ (Triangulated Irregular Network)*

Environmental Systems Research Institute, Inc.

380 New York Street

Redlands, CA 92373



TIN is a set of tools that creates, analyzes, and displays digital elevation data. TIN provides surface analysis functions commonly used by scientists, engineers, and landscape architects.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* S. J. Camarata, (714) 793-2853

• **VESPA™**

Sierra Geophysics, Inc.

11255 Kirkland Way

Kirkland, WA 98033

VESPA simulates seismic profiles in parallel layered viscoelastic earth structures with the generation of offset and zero-offset vertical seismic profiles and surface and seismic records for a variety of source types.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Gary M. Lundquist, (206) 822-5200

• **WELLPLAN**

Drilling Resources Development Corporation

6111 East Skelly Drive

Skyline East I Building

Suite 415

Tulsa, OK 74135

WELLPLAN combines advanced engineering analysis and morning report data management to provide users with an integrated systems approach. WELLPLAN includes tailorable screen layouts, screen editing, and BHA analysis.

*Source Language:* FORTRAN-77

*Price Range:* \$2,300-\$96,000

*Contact:* James B. Williams, (918) 664-9010

- **Z-CAP™**

Zycor, Inc.  
220 Foremost Drive  
Austin, TX 78745

Z-CAP digitizes downhole geologic and petrophysical data, cultural and geomorphic information, seismic sections, shot-point locations, property boundaries, and contour data for the energy and mineral industries.

*Price Range:* Available upon request

*Contact:* Mark Franke, (512) 282-6699

- **Z-EDIT™**

Zycor, Inc.  
220 Foremost Drive  
Austin, TX 78745

Z-EDIT reinterprets data using interactive graphics. It lets users erase and redraw contours, introduce and modify faults, and add or change data. Z-EDIT then regenerates the grid and contours it on the screen.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Mark Franke, (512) 282-6699

- **Z-MAP™**

Zycor, Inc.  
220 Foremost Drive  
Austin, TX 78745

Z-MAP produces grids and surface displays from geological and geophysical data like formation tops, zone thicknesses, average porosity, times, or velocities. It displays contour maps, multilayer cross sections or 3D views.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Mark Franke, (512) 282-6699

▪ **Electrical—Nuclear Engineering**

▪ **I-G SPICE**

AB Associates, Inc.

P. O. Box 82215

Tampa, FL 33682

I-G SPICE is an interactive graphics version of the SPICE 2 program that retains all of SPICE 2's capabilities. It features user-specified equations and tabular functions, multiple plots and plot window expansions, and more.

*Source Language:* FORTRAN-77

*Price Range:* \$19,500–\$39,000

*Contact:* Dr. James C. Bowers, (813) 932-9853

▪ **Electronic Engineering**

▪ **Bravo3® Automatic Layout Editor™**

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986

Automatic Layout Editor is an automatic placement and routing system for high-density digital and analog PCBs. It supports surface mount technology and component placement on both sides of the board.

*Source Language:* FORTRAN, PL/1

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

▪ **Bravo3® Design Capture**

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986



Design Capture is a hierarchical schematic capture system that provides menu pick interfacing to SPICE and CADAT simulators. The graphical and textual tools let users meet most schematic documentation standards.

*Source Language:* Pascal, C

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

• *Bravo3® PCB Component Insertion Program™*

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986

This product is a parameter table program that can generate output that is compatible with most component insertion and pick and place machines. It supports radial, axial, dip, and surface mount packages.

*Source Language:* PL/1, C

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

• *Bravo3® PCB Interactive Layout Editor™*

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986

This 3D interactive layout editor allows PCB designers to place and route components on both sides of a printed circuit board. It interfaces with mechanical analysis and documentation systems.

*Source Language:* PL/1, C

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

• **Bravo3® PCB Layout and Mechanical Packaging™**

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

This layout and mechanical packaging product provides interactive PCB schematic documentation for reformatting within Design Capture and direct input into other Bravo3 interactive or automatic layout products.

*Source Language:* PL/1, C

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

• **Bravo3® PCB NC Drill™**

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

PCB NC Drill generates drill tapes compatible with Excellon and Trudrill formats. It sorts drill data by drill size and by plated and nonplated holes. The drill path can be graphically displayed for visual verification.

*Source Language:* PL/1, C

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

• **CADES-G**

Cade GmbH  
Hirschstrasse 98  
D-7903 Laichingen  
West Germany

CADES-G is a CAD system for designing printed circuit boards. It provides structured input and documentation of connectivity data, gridless routing, interfaces for simulation in-circuit testing, and more, in one central database.

*Source Language:* FORTRAN-77, C

*Price Range:* DM295.000

*Contact:* Horst Meinken, 49 733 316069

• **CANDE®**

Technology Modeling Associates, Inc.

300 Hamilton Avenue

Third Floor

Palo Alto, CA 94301

CANDE, a device simulation program, models the 2D distributions of potential and carrier concentrations in a device to predict its electrical characteristics for any bias condition. It solves Poisson's equation and more.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Robin L. Cole, (415) 327-6300

• **DDS-C (Drafting Design System-cabling)**

Cade GmbH

Hirschstrasse 98

D-7903 Laichingen

West Germany

DDS-C is a CAE set of software modules for constructors and producers of electrotechnic systems. It generates and administers schematics, layouts of control panels, front panels, and required documentation for verification.

*Source Language:* FORTRAN, MACRO assembler

*Price Range:* DM140.000-DM190.000

*Contact:* Horst Meinken, 49 733 316069



- **DEPICT™-2**

Technology Modeling Associates, Inc.  
300 Hamilton Avenue  
Third Floor  
Palo Alto, CA 94301

DEPICT-2 simulates the topographical evolution of a device during processing. It simulates the photolithography, deposition, and etching steps required to fabricate ICs.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Robin L. Cole, (415) 327-6300

- **Design Validation System**

Valid Logic Systems, Inc.  
2820 Orchard Parkway  
San Jose, CA 95134

This system is aimed at logic designers who need a CAE package to verify entire system designs. It includes analysis software, a graphics editor, a logic simulator, a timing verifier, a number of libraries, and more.

*Source Language:* Pascal, C

*Price Range:* \$8,800-\$85,000

*Contact:* Ben Tang, (408) 432-9400

- **DIGSIM®**

Digsim Systems  
Box 10 004  
S-580 10 Linköping  
Sweden

DIGSIM aids electronic design, test verification, and documentation of custom circuits, modules, printed circuit boards, and complete systems. It provides design capture, top-down methodology, a symbol editor, and more.

*Source Language:* C

*Price Range:* \$4,500-\$100,000

*Contact:* Dr. Bengt Magnhagen, 46 13 212020

▪ **DRACULA**

Cadence Design Systems, Inc.

555 River Oaks Parkway

San Jose, CA 95134

DRACULA, used by companies that design or manufacture integrated circuits, is a family of layout verification tools that allows its users to verify each step of the IC layout design process.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Gary Lambert, (408) 943-1234

▪ **HILO-3® Universal Logic Simulation System**

GenRad, Inc.

Design Engineering Group

510 Cottonwood Drive

Milpitas, CA 95035

HILO-3 is an integrated set of software tools for logic verification, fault simulation, and test generation in circuit design. The hierarchical framework supports three structured design methodologies.

*Source Language:* C

*Price Range:* Available upon request

▪ **HSPICE™**

Meta-Software, Inc.

50 Curtner Avenue

Suite 16

Campbell, CA 95008

HSPICE is an analog electronic circuit simulator that incorporates models as well as the input styles of Berkeley SPICE and other simulators. It performs various analyses of the circuit using the Newton-Raphson technique.

*Source Language:* FORTRAN-77

*Price Range:* \$8,000-\$70,000

*Contact:* Jeff Langner, (408) 371-5100

▪ *IC Design System*

Valid Logic Systems, Inc.

2820 Orchard Parkway

San Jose, CA 95134

IC Design System combines workstation-based CAE tools with IC layout software. Schematic capture, simulation, layout editing, and analysis run from one database. The system provides hierarchical mask verification.

*Source Language:* Pascal, C

*Price Range:* \$37,500-\$95,000

*Contact:* Donna Rigali, (408) 432-9400

▪ *InfoSCHEM*

Ferranti Infographics Ltd.

Bell Square

Brucefield

Livingston

West Lothian EH54 9BY

Scotland, United Kingdom

InfoSCHEM offers drafting productivity by using InfoCAD's 2D capabilities together with its own facilities to provide a schematic data capture system that has the ability to create its own database.

*Source Language:* C

*Price Range:* Available upon request

*Contact:* J. D. Paton, 44 506 411583



- *LASAR™ (Logic Automated Stimulus and Response)*

Teradyne EDA, a division of Teradyne, Inc.  
321 Harrison Avenue  
Boston, MA 02118

This product is a total logic simulation system for VLSI devices and printed circuit boards that accurately predicts the responses of a software circuit model to test vectors for design verification and test generation.

*Source Language:* FORTRAN, C

*Price Range:* \$25,000–\$280,000

*Contact:* Ray Essington, (617) 482-2700

- *MilStress™*

MGA, Inc.  
73 Junction Square Drive  
Concord, MA 01742

This reliability prediction model based on DoD MILHDBK-217 allows circuit designers and reliability engineering specialists to assess design reliability by investigating circuit and component sensitivity.

*Source Language:* FORTRAN

*Price Range:* \$6,000–\$12,000

*Contact:* John Rodrigues, (508) 369-5115

- *Phase One VLSI Software Suite*

Integrated Silicon Design Pty. Ltd.  
230 North Terrace  
Adelaide SA 5000  
Australia

This custom integrated circuit design tool has a hierarchical mask-level editor, corner-based design rule checker, edge-based circuit extractor, circuit-level simulator with graphical output, and electric rules checker.

*Source Language:* C

*Price Range:* \$15,000-\$32,000

*Contact:* L. A. Varzaly, 61 8 2235802

• *Phase Two VLSI Software Suite*

Integrated Silicon Design Pty. Ltd.

230 North Terrace

Adelaide SA 5000

Australia

This custom integrated circuit design tool contains an interactive graphics editor for symbolic design and a corresponding symbolic virtual segment compactor. It enters the leaf cell design in symbolic netlist form.

*Source Language:* C

*Price Range:* \$20,000-\$40,000

*Contact:* L. A. Varzaly, 61 8 2235802

• *PISCES®-2B*

Technology Modeling Associates, Inc.

300 Hamilton Avenue

Third Floor

Palo Alto, CA 94301

PISCES-2B is a device simulation program used to develop MOS and bipolar integrated circuits. It models 2D distributions in a device to predict its electrical characteristics for any bias condition.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Robin L. Cole, (415) 327-6300

- **PRECISE®**

Electrical Engineering Software, Inc.  
4675 Stevens Creek Boulevard  
Santa Clara, CA 95051

PRECISE is a simulation program for analog circuit designers that helps engineers test circuit functioning, view circuit response to environmental changes, and analyze statistical part variations and component values.

*Source Language:* FORTRAN-77

*Price Range:* \$6,000-\$75,000

*Contact:* Kevin Walsh, (408) 296-8151

- **Saber™**

Analogy, Inc.  
P. O. Box 1669  
Beaverton, OR 97075

Saber is a simulator used to design linear and nonlinear analog electronic systems. It allows top-down design from the system level to the circuit level. The user can simulate digital circuits and nonelectrical systems.

*Source Language:* FORTRAN

*Price Range:* \$15,000-\$100,000

*Contact:* Doug Johnson, (503) 626-9700

- **SALT™ (Simulation Analysis for Logic and Timing)**

CGI-CAD Group, Inc.  
3911 Portola Drive  
Santa Cruz, CA 95062

SALT is an event-driven, 36-state, multilevel, mixed-mode simulator used to predict total propagation delay during simulation. Users can verify circuit design and timing while generating test vectors for the actual device.



*Source Language:* C

*Price Range:* \$15,000-\$60,000

*Contact:* Vinnie Apicella, (408) 475-5800

▪ **SCICARDS®**

Harris/Scientific Calculations, Inc.

7796 Victor-Mendon Road

Fishers, NY 14453

SCICARDS is a single-version, dedicated, automatic, and interactive design system for component placing and routing in PCB design technologies. It includes automatic swapping, macro commands, and continuous dynamic checking.

*Source Language:* FORTRAN, C

*Price Range:* \$25,000

*Contact:* Steve Testa, (716) 924-9303

▪ **SDM (Symbolic Drawing Machine)**

CADMATICS

21941 Ybarra Road

Woodland Hills, CA 91364-4237

SDM is a program for the interactive development of circuit diagrams, flowcharts, database structures, and other symbolic diagrams using symbols, character strings, parameterized figures, and subpictures.

*Source Language:* MACRO-11

*Price Range:* \$2,500

*Contact:* John S. Thorne, (818) 884-8957

▪ **Silvar-Lisco / CAL-PC™**

Printed Circuit Board) )

Silvar-Lisco

1080 Marsh Road

Menlo Park, CA 94025

CAL-PC is an interactive printed circuit board layout system used for the complex design of PCBs. It consists of tools for design entry, packaging, automatic placement routing, manufacturing output, back annotation, and more.

*Source Language:* FORTRAN

*Price Range:* \$40,000-\$80,000

*Contact:* Jan Geusens, (415) 324-0700

▪ *Silvar-Lisco/Logan™ (Logic Analyzer)*

Silvar-Lisco

1080 Marsh Road

Menlo Park, CA 94025

This product is an interactive graphics program that supports interactive display of simulator output. Users can display the circuit schematic and select nets to view in waveform.

*Source Language:* Pascal

*Price Range:* \$5,000-\$10,000

*Contact:* Jan Geusens, (415) 324-0700

▪ *Silvar-Lisco/LOGIX-SL™ (Logic Simulator)*

Silvar-Lisco

1080 Marsh Road

Menlo Park, CA 94025

This logic simulator is designed for structured simulation of electronic systems. It performs functional unit-delay and variable-delay simulation; users can interactively view simulation results.

*Source Language:* Pascal

*Price Range:* \$10,000-\$20,000

*Contact:* Jan Geusens, (415) 324-0700

▪ *Silvar-Lisco/Princess™ Full Custom Layout Software*

Silvar-Lisco  
1080 Marsh Road  
Menlo Park, CA 94025

This product is a semi- and full-custom integrated circuit layout software system for the electronic design industry. It consists of a graphics editor and project management system, and can interface with CAD systems.

*Source Language:* FORTRAN, Pascal, C, LISP

*Price Range:* \$25,000-\$35,000

*Contact:* Jan Geusens, (415) 324-0700

▪ *Silvar-Lisco/SDS™*

Silvar-Lisco  
1080 Marsh Road  
Menlo Park, CA 94025

This schematic capture program provides graphics tools to create logic symbols, manages and organizes interconnect information, and provides results in a format useable by a variety of simulators.

*Source Language:* Pascal, FORTRAN

*Price Range:* Available upon request

*Contact:* Jan Geusens, (415) 324-0700

▪ *Silvar-Lisco/UDRC™ (Universal Design Rule Check)*

Software  
Silvar-Lisco  
1080 Marsh Road  
Menlo Park, CA 94025

This software processes design rules and conditional checks, and performs spacing and width checks. Features include a command language that allows spacing and width checks to be expressed as one line commands.



*Source Language:* FORTRAN, C, Assembler

*Price Range:* \$10,600-\$63,200

*Contact:* Jan Geusens, (415) 324-0700

- *The SIMON SIMULATOR*

ECAD, Inc.

2455 Augustine Drive

Santa Clara, CA 95054

The SIMON SIMULATOR is useful for analyzing large circuits like those found in digital MOS design. It can function like a logic simulator, and can analyze and identify output signals.

*Source Language:* C, MACRO assembler

*Price Range:* \$15,000-\$70,000

*Contact:* Dale Pollek, (408) 727-0264

- *SUPRA®*

Technology Modeling Associates, Inc.

300 Hamilton Avenue

Third Floor

Palo Alto, CA 94301

SUPRA simulates fabrication processes for nonplanar MOS and bipolar devices. It models a variety of device structures composed of as many as 8 implantation masking layers. This version offers additional enhancements.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Robin L. Cole, (415) 327-6300

- *SYMBAD BPR*

Cadence Design Systems, Inc.

555 River Oaks Parkway

San Jose, CA 95134

Symbad is a family of integrated layout design tools that allows its users to interactively perform each step of an IC layout design. It includes floor planning, polygon-based editing, object-based editing, symbolic compaction, and block-oriented placement and routing.

*Price Range:* Available upon request

*Contact:* Gary Lambert, (408) 943-1234

• **TOPEX®**

Technology Modeling Associates, Inc.

300 Hamilton Avenue

Third Floor

Palo Alto, CA 94301

TOPEX, a general-purpose tool that fits mathematical models to measured or simulated data, extracts parameters for circuit simulation and has built-in SPICE MOS and bipolar transistor models. It offers graphics and more.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Robin L. Cole, (415) 327-6300

• **Vanguard CAE Design System**

Teradyne EDA, a division of Teradyne, Inc.

5155 Old Ironsides Drive

Santa Clara, CA 95054

This system for electronic design includes symbolic hierarchical schematic capture, integrated simulator and timing verifier interfaces, PCB layout and manufacturing tools, and a mixed text and graphics editor.

*Source Language:* Pascal

*Price Range:* Available upon request

*Contact:* Marcia Murray, (408) 748-7761

- **VERILOG™ and VERILOG-XL™**

Gateway Design Automation Corporation  
2 Lowell Research Center Drive  
Lowell, MA 01852-4995

VERILOG is a mixed-level digital design language and interactive simulation system for gate and switch-level circuit simulation. It accurately predicts the responses of a software circuit model to test vectors for design verification of VLSI devices and printed circuit boards.

*Source Language:* C

*Price Range:* Available upon request

*Contact:* Martin Koechel, (508) 458-1900

- **VISULA PLUS™**

Racal-Redac, Inc.  
238 Littleton Road  
Westford, MA 01886

This electronic design automation system links all stages of a company's design operation, including design capture, design verification, physical layout, and manufacturing.

*Source Language:* C

*Price Range:* \$30,000-\$80,000

*Contact:* David DeMaria, (508) 692-4900

- **VTI VLSI™ Design System**

VLSI Technology, Inc.  
1109 McKay Drive, M/S 33  
San Jose, CA 95131

This integrated system for the design of integrated circuits is meant for electronics manufacturers who use the company's silicon-processing plant. It supports full-custom and semicustom IC designs.

*Price Range:* Available upon request

*Contact:* Mark Saul, (408) 434-7681



## • Mechanical Engineering

### • ADAMS® (*Automatic Dynamic Analysis of Mechanical Systems*)

Mechanical Dynamics, Inc.  
3055 Plymouth Road  
Ann Arbor, MI 48105

ADAMS is a general-purpose engineering application for the design and development of mechanical systems. It features analysis capabilities, integrates information from third-party applications, and more.

*Source Language:* FORTRAN-77

*Price Range:* \$36,000–\$180,000

*Contact:* Jim Molnar, (313) 994-3800

### • ADINA

Adina R&D, Inc.  
71 Elton Avenue  
Watertown, MA 02172

ADINA performs effective finite element analysis of structural, heat transfer, field, and fluid flow problems. It can be used by the civil, mechanical and aerospace, nuclear, off-shore, and geomechanical industries.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Dr. Jan Walczak, (617) 926-5199

### • ADLPIPE-Piping Analysis

ADLPIPE, Inc.  
Two Tyler Court  
Cambridge, MA 02140

ADLPIPE features stress analysis of a complex piping system, input in free or fixed format, plotting, input or output in English, metric, or SI units providing both load and modeling.

*Source Language:* FORTRAN IV

*Price Range:* \$16,000-\$65,000

*Contact:* I. W. Dingwell, (617) 492-1991

• *Bravo3 2D and 3D Mechanisms*

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986

These tools are for evaluating 2D and 3D motion. Users can construct mechanical assemblies, perform kinematic and dynamic analyses, and display results. Displays include animation, tabular output, and more.

*Source Language:* PL/1

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

• *DIS (Design Integration System)*

ADLPIPE, Inc.

Two Tyler Court

Cambridge, MA 02140

DIS is an integrated group of design, engineering analysis, and drafting programs for the power, petrochemical, and process industries. Piping designs may be developed by 3D CAD systems interfacing to other programs.

*Source Language:* FORTRAN IV

*Price Range:* \$15,000-\$100,000

*Contact:* I. W. Dingwell, (617) 492-1991

▪ *MTS LAP (Life Analysis Package)*

MTS Systems Corporation  
Box 24012  
Minneapolis, MN 55424

MTS LAP assists engineers in applying signal and low cycle fatigue and damage analysis techniques. It includes signal display and editing and manipulation features, damage and fatigue life analysis, and graphics tools.

*Source Language:* FORTRAN  
*Price Range:* \$18,000-\$200,000  
*Contact:* Gail Leese, (612) 937-4330

▪ *NEKTON™*

Nektonics, Inc.  
P. O. Box 22  
Bedford, MA 01730

NEKTON solves incompressible, unsteady Navier-Stokes and energy equations by the spectral element method and is suited for detailed calculations of flows in the laminar and transitional regimes.

*Source Language:* ANSI FORTRAN-77  
*Price Range:* \$20,000-\$100,000  
*Contact:* Brian M. McCay, (617) 275-4011

▪ *NextCAD™*

NOVACAD  
54 R Industrial Way  
Wilmington, MA 01887

NextCAD allows the user to scan existing manually created documents on paper or film to produce digital data. The user can also create new documents directly by using NextCAD sketch draft or to transfer documents from other CAD systems.



*Source Language:* C  
*Price Range:* \$5,000-\$7,000 per seat  
*Contact:* Ray Ciliv, (508) 658-8883

▪ *The PATRAN System*<sup>TM</sup>

PDA Engineering  
2975 Redhill Avenue  
Costa Mesa, CA 92704

PATRAN is a 3D MCAE environment composed of PATRAN Plus, application modules, application interfaces, and gateway utilities. Open-ended architecture permits access to other design, analysis, or manufacturing software.

*Source Language:* FORTRAN-77  
*Price Range:* Available upon request  
*Contact:* Susan Wise, (714) 540-8900

▪ *THERMAL*

KCR Products  
535 Lace Lane  
P.O. Box 1415  
Burleson, TX 76028

THERMAL is a technical routine that provides user-oriented methods for temperature analysis of structures that house mechanisms giving off heat. It is capable of analyzing up to 2500 nodes for minicomputers and mainframes.

*Source Language:* FORTRAN  
*Price Range:* \$900  
*Contact:* Donne Reese, (817) 447-8439

- **Transportation—Marine Engineering**

- **CBUMP**

Concept Analysis Corporation  
14789 Keel Street  
Plymouth, MI 48170

CBUMP calculates the phenomenon of impact for automotive bumper systems and is a tool for sizing bumpers and predicting the optimum energy-absorber device, peak force, deflection, absorber, and so on, in bumper beams.

*Source Language:* FORTRAN-77

*Price Range:* \$22,000

*Contact:* Fred Sheill, (313) 455-2340

- **Facilities Management**

- **Corporate Communications**

- *The NYNEX Corporate Connection*

NYNEX Computer Services Company  
2 Blue Hill Plaza  
First Floor  
Pearl River, NY 10965

This software assists companies in communicating with their employees. Information can be communicated over kiosks or through existing or planned desktop terminals, personal computers, or office automation systems.

*Source Language:* C

*Price Range:* \$50,000—\$5,000,000

*Contact:* Marc Maltz, (914) 620-5207

## ▪ Facilities Scheduling—Space Scheduling

### ▪ *Facility Requirements Programmer™*

The Computer-Aided Design Group  
4215 Glencoe Avenue  
Marina del Ray, CA 90292

This product analyzes present and future space needs for entire organizations as well as for individual workstations. It forecasts requirements for personnel, equipment, and support space over time, and is part of CADG+FM.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Peggy Little, (213) 821-2100

### ▪ *FAMES®*

Decision Graphics, Inc.  
200 Friberg Parkway  
Two Westborough Business Park  
Westborough, MA 01581

This interactive graphics package lets the user enter, store, and report on all space in a facility. FAMES allows facility managers to capture space allocations, report on them, and plot plans showing space utilization.

*Source Language:* FORTRAN

*Price Range:* \$6,400

*Contact:* Gary Wuenn, (508) 870-5900



## • General—Operating System

### • *SoftPC™*

Insignia Solutions Inc.  
Suite 300  
25 Burlington Mall Road  
Burlington, MA 01803

This product allows workstation users to run MS-DOS applications in their workstation without any added hardware. Enjoy the capabilities of a real IBM PC right down to the CPU, disks, floppies, screen, communication ports, and keyboard.

*Source Language:* C, MACRO 32 (not required)

*Price Range:* \$498

*Contact Name:* Bill McCarthy, (617) 270-0612

## • Graphics

### • Chart and Map Generators

#### • *DTM/TVES*

Laser-Scan Laboratories Ltd.  
Cambridge Science Park  
Milton Road  
Cambridge CB4 4FY  
England, United Kingdom

DTM/TVES is a package for the creation, validation, and exploitation of a 3D representation of the earth's surface. Typical datasets have over a million points. It meets the requirements of military and environmental users.

*Source Language:* FORTRAN-77

*Price Range:* £8,000–£30,000

*Contact:* Martin R. Pollock, 44 223 315414

▪ *LAMPS (Laser-Scan Automated Map Production System)*

Laser-Scan Laboratories Ltd.  
Cambridge Science Park  
Milton Road  
Cambridge CB4 4FY  
England, United Kingdom

LAMPS comprises vector-based map processing software, including digitizing, interactive editing, transformation, and plotting. It handles maps of all scales, including topographic and thematic maps and air and sea charts.

*Source Language:* FORTRAN-77

*Price Range:* £5,000-£20,000

*Contact:* Martin R. Pollock, 44 223 315414

▪ **File Conversion**

▪ *Family of Translators*

Black & Veatch  
1500 Meadow Lake Parkway  
P. O. Box 8405  
Kansas City, MI 64114

This software converts files of drawings from one CAD system to another. A neutral file is generated directly from applications programs with a few simple commands. The file may be displayed and edited before translation.

*Price Range:* \$3,500-\$10,000

*Contact:* C. W. Keller, (913) 339-2000

▪ **Graphics Device Drivers**

▪ **AddSys-3000™**

Precision Visuals, Inc.  
6260 Lookout Road  
Boulder, CO 80301

This device-access software provides the functionality required for applications such as computer-aided design, data analysis, mapping, scientific data display, simulation, and process control.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Chris Logan, (303) 530-9000

▪ **VAX DECOR**

Digital Equipment Corporation  
146 Main Street  
Maynard, MA 01754-2571

This graphics subroutine package provides an interface between an application program and graphics devices. The interface is device independent and supports user-developed device handlers, as well as those supplied by DEC.

*Price Range:* Available upon request

*Contact:* Consult your local Digital Sales Office.

▪ **Image Generators—Image Plotting**

▪ **Re:Design**

Impell Computer Systems  
2201 Dwight Way  
Berkeley, CA 94704



Re:Design is a CAD program that operates in an overlay mode on drawing images captured from digital scanners. It features geometric construction tools, line and text fonts, dimensioning techniques, and more.

*Source Language:* C

*Price Range:* \$10,000

*Contact:* Jerry A. Goedicke, (415) 549-9119

## ▪ **Software Tools for Graphics**

### ▪ *BLOX™ Graphics Builder*

Rubel Software

P. O. Box 1035

Cambridge, MA 02140

BLOX is a tool for creating graphics applications programs that use a mouse or other pointing device. It interactively draws icons, menus, and screen layouts and automatically creates an online HELP file.

*Source Language:* FORTRAN-77

*Price Range:* \$11,000

*Contact:* Eve M. Goldfarb, (617) 876-7993

### ▪ *CPS-3™*

Radian Corporation

8501 Mo-Pac Boulevard

P. O. Box 201088

Austin, TX 78720-1088

CPS-3, a modular, open architecture system, uses a layered approach that allows users to replace any layer with a customized layer and offers three modes: conversational, graphically interactive, and batch.

*Source Language:* FORTRAN

*Price Range:* \$20,000–\$170,000

*Contact:* Michael Haecker, (512) 454-4797

• *GINO-F*

Bradly Associates Ltd.  
Manhattan House  
140 High Street  
Crowthorne  
Berkshire RG11 7AT  
England, United Kingdom

GINO-F handles graphics input and output written in ANSI standard FORTRAN. It includes drawing, control, administration, transformation, segment handling, and graphics input routines.

*Source Language:* Assembler, FORTRAN

*Price Range:* £500–£13,000

*Contact:* K. N. Bradly, 44 344 779381

• *GINOSURF*

Bradly Associates Ltd.  
Manhattan House  
140 High Street  
Crowthorne  
Berkshire RG11 7AT  
England, United Kingdom

GINOSURF provides facilities for displaying 3-D surfaces as contour maps or as isoparametric projections. Users provide the surface height at randomly spaced points and a single call displays the surface.

*Source Language:* FORTRAN

*Price Range:* £500-£13,000

*Contact:* K. N. Brady, 44 344 779381

• **GK-2000®**

Precision Visuals, Inc.

6260 Lookout Road

Boulder, CO 80301

GK-2000, a graphics tools package of more than 230 callable subroutines, enables programmers to develop two-dimensional applications that are independent of a specific output device.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Chris Logan, (303) 530-9000

• **GRAFFPAK-GKS**

Advanced Technology Center

5711 Slauson Avenue

Suite 238

Culver City, CA 90230

This ANSI/ISO GKS implementation provides functions for developing graphics applications. It includes machine- and device-independent graphics output, FORTRAN and C bindings, and GKSM and CGM metafiles.

*Source Language:* FORTRAN, C

*Price Range:* \$495-\$20,000

*Contact:* Ingrid Richardson, (213) 568-9119

• **HOOPS™ Graphics**

Ithaca Software, Inc.

902 West Seneca Street

Ithaca, NY 14850



HOOPS Graphics is a library of 3D graphics routines that controls all aspects of geometric modeling, viewing, rendering, and user interaction. It is used for the development of device-independent applications.

*Source Language:* C

*Price Range:* \$575-\$15,000

*Contact:* Aline Bernstein, (607) 273-3690

▪ *PRIOR GKS/C*

PRIOR Data Sciences Ltd.  
240 Michael Cowpland Drive  
Kanata  
Ontario K1M 1P6, Canada

This level 2b implementation of the ANSI and ISO GKS standard provides graphic subroutine library output calls and request input. It supports level 2c, including sample and event input, for selected devices.

*Source Language:* C, FORTRAN

*Price Range:* \$2,000-\$10,000

*Contact:* Lawrence Northway, (613) 591-7235

▪ *DEC GKS (Graphical Kernel System)*

Digital Equipment Corporation  
146 Main Street  
Maynard, MA 01754-2571

DEC GKS provides a single interface to portable, device-independent graphics application development. It provides full input and output capabilities and implements the ISO and ANSI GKS standard for 2D graphics.

*Price Range:* Available upon request

*Contact:* Consult your local Digital Sales Office.

- *SL-Graphics Modeling System (SL-GMS™, SL-GMS-D™, SL-DRAW™)*

Sherrill-Lubinski  
Suite 110 Hunt Plaza  
240 Tamal Vista Blvd.  
Corte Madera, CA 94925

SL-Graphics Modeling System is an object oriented framework that builds graphics models as well as provides interactive man-machine interfaces. The SL-Graphics Modeling System allows connection of graphics to real-time data.

*Source Language:* Fortran, C, ADA  
*Price Range:* Available upon request  
*Contact:* Linda Mobley, (415) 927-1724

- *DEC PHIGS*

Digital Equipment Corporation  
146 Main Street  
Maynard, MA 01754-2571

This 3D graphics support system controls the definition, modification, and display of hierarchical graphics data. It is device-independent and manages the organization and display of data in a centralized database.

*Price Range:* Available upon request  
*Contact:* Consult your local Digital Sales Office.

- **Industries**

- **Banking—Finance**

- *The NYNEX Banking Connection*

NYNEX Computer Services Company  
2 Blue Hill Plaza  
First Floor  
Pearl River, NY 10965

This is a self-service banking system that enables banks to sell products, service customers, and increase productivity. It provides access to a bank's existing customer service department.

*Source Language:* C, BASIC, 4GL

*Price Range:* \$15,000-\$5,000,000

*Contact:* Marc Maltz, (914) 620-5207

• **TRADE™**

Micrognosis International  
Centrepont

103 New Oxford Street

Floor 31-32

London WC1A 1RD

England, United Kingdom

TRADE provides a solution for financial information distribution handling. It consolidates information and allows users to carry out real-time calculations, manipulations, and analysis.

*Source Language:* C

*Price Range:* £10,000-£30,000

*Contact:* Janet Wood, 44 1 5288282

• **Communications—Telecommunications**

• **TEAMS (Telecommunications Engineering and Asset Management System)**

McDonnell Douglas Communications

Industry Systems Company

5299 DTC Boulevard

Suite 1400

Englewood, CO 80111-3397

TEAMS is an integrated approach to mechanizing the engineering and asset management requirements for the



telecommunications industry. It allows facilities engineers to monitor the complete engineering process.

*Source Language:* C, FORTRAN

*Price Range:* \$250,000-\$5,000,000

*Contact:* Sandy Smith, (303) 220-6182

## ▪ **Distribution—Retail—Wholesale**

### ▪ *The NYNEX Consumer Connection*

NYNEX Computer Services Company

2 Blue Hill Plaza

First Floor

Pearl River, NY 10965

This software helps retailers reach customers in stores, shopping centers and malls, office complexes, universities, and other public places. It uses opinion polls, games, and response demanding prompts for presentations.

*Source Language:* C

*Price Range:* \$15,000-\$2,500,000

*Contact:* Marc Maltz, (914) 620-5207

## ▪ **Education—Libraries**

### ▪ *CAM-CAL2®*

ICAM Technologies Corporation

1900 Sources Boulevard

Pointe Claire

Quebec H9R 4Z3, Canada

CAM-CAL2 teaches APT and APT programming for all types of NC machines using computer-aided learning techniques to establish the relationships between part geometry, tool motions/instructions, and APT statements.

*Source Language:* FORTRAN

*Price Range:* \$2,750-\$6,510

*Contact:* Rak Bhalla, (514) 697-8034

▪ **Energy—Mining**

▪ **CLASS** (*Computerized Log Analysis Software System*)

Petroleum Computing, Inc.  
4925 Greenville Avenue  
Suite 600  
Dallas, TX 75206

This menu-driven, modular software for petrophysical well log analysis includes environmental corrections to log data, geological models for data analysis, color graphics, data entry via tape or digitizer, and more.

*Source Language:* FORTRAN-77

*Price Range:* \$75,000–\$300,000

*Contact:* Mickey P. Head, (214) 692-0818

▪ **DATAMINE®**

Mineral Industries Computing Ltd.  
1-2 Langham Place  
London W1N 7DD  
England, United Kingdom

DATAMINE provides general statistical processing, geo-statistics, generalized data transformation, and drillhole data processing. It handles mine design and evaluation.

*Source Language:* FORTRAN

*Price Range:* \$10,000–\$100,000

*Contact:* Katharine Harwood, 44 1 5800553

▪ **ES-LOG™** (*Energy Systems-LOG*)

Energy Systems Technology, Inc.  
1560 Broadway  
Suite 901  
Denver, CO 80202

ES-LOG is a down hole well log analysis program used by geologists, reservoir engineers, and well log analysts in mid-size to large oil exploration and production companies. It features color graphics and a range of models.

*Source Language:* Pascal

*Price Range:* \$20,000-\$400,000

*Contact:* David L. Arnold, (303) 861-2424

#### • GRID

ECL Petroleum Technologies

101 Sixth Avenue SW

Suite 2500

Calgary

Alberta T2P 3P4, Canada

GRID is an interactive program used to build reservoir models, design simulation grids, and produce input data for reservoir simulators such as ECLIPSE. The model may be digitized or input directly from map files.

*Source Language:* FORTRAN-77

*Price Range:* \$30,000-\$70,000

*Contact:* Dawn Robinson, 44 491 575989

#### • MINEX®

Exploration Computer Services, Inc.

ECS House

500 Moss Vale Road

Bowral NSW 2576

Australia

MINEX is an integrated system incorporating a borehole database, geological modeling, mine reserves, mine scheduling, dragline simulation systems, and more. It includes HELP and custom menu-writing facilities.

*Source Language:* FORTRAN, C

*Price Range:* \$10-\$200

*Contact:* Jon Barber, (817) 383-2908



▪ **MINEX 3D**

Exploration Computer Services, Inc.  
ECS House  
500 Moss Vale Road  
Bowral NSW 2576  
Australia

MINEX 3D evaluates orebodies and aids in planning open-cut and underground mines. It incorporates drillhole data management, 3D geological modeling, mine design and recoverable reserves estimation, and more.

*Source Language:* FORTRAN, C  
*Price Range:* \$12,000-\$70,000  
*Contact:* Jon Barber, (817) 383-2908

▪ **SimEase™**

Scientific Software-Intercomp  
10333 Richmond Avenue  
Suite 1100  
Houston, TX 77042-4122

This interactive graphics input and results processor for reservoir simulation analyzes and formats data. A simulator analyzes the results and presents them as 3D, contour, or color-shaded maps or cross sections.

*Source Language:* FORTRAN  
*Price Range:* Available upon request  
*Contact:* Laurie Marvin, (303) 292-1111

▪ **Spatial/II**

Digital Equipment Corporation  
146 Main Street  
Maynard, MA 01754-2571

Spatial/II is an application integration tool designed for the petroleum exploration/production and mapping applications

markets. Users can store, edit, manipulate, and display geographically (locationally) defined data.

*Price Range:* Available upon request

*Contact:* Consult your local Digital Sales Office.

## ▪ **Manufacturing Industries**

### ▪ *Medusa Manufacturing System*

Computervision Medusa

Harston Mill

Royston Road

Harston

Cambridge CB2 5NL

England, United Kingdom

This system comprises modules for 2-axis turning, 2.5-axis milling, and sheet metal design and manufacture. A drawing is annotated to indicate profiles to be machined, and the tooling, techniques, and sequence of work.

*Source Language:* FORTRAN, C

*Price Range:* £7,500

*Contact:* Hilary Jarvis, 44 223 871717

## ▪ **Media—Publishing**

### ▪ *The NYNEX Public Connection*

NYNEX Computer Services Company

2 Blue Hill Plaza

First Floor

Pearl River, NY 10965

This software integrates media that provide computer-generated graphics, color video display monitors, closed circuit video networks, electronic signage, large stadium type displays, and interactive information centers.

*Source Language:* C

*Price Range:* \$500,000-\$5,000,000

*Contact:* Marc Maltz, (914) 620-5207

▪ **Medical—Health Care**

▪ **PLAN-32®**

Oncology Systems, Inc.

10777 Main Street

Suite 202

Bellevue, WA 98004

PLAN-32 provides computer-assisted planning of cancer radiation therapy. PLAN-32 supports multiple workstations and uses color graphics, beam planning, dose distribution, and computer tomography.

*Source Language:* VAX Pascal

*Price Range:* \$39,500

*Contact:* Anthony C. Naughtin, (206) 454-5255

▪ **Process Industries**

▪ **PROCOP™**

Cisigraph

76 rue des Gémeaux

SILIC 413

F-94573 Rungis Cedex

France

PROCOP, developed for the plastics industry, part designers and processors, and mold manufacturers, designs and manufactures plastic parts, simulates the flow of polymers within molds, evaluates mechanical stress, and more.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* D. Capon, 33 42899323



## ▪ **Services—Professions**

### ▪ *DOGS Architecture*

Waterland Automatisering BV  
Gorslaan 10  
1441 RG Purmerend  
Netherlands

This system includes the benefits of DOGS and special features for the architect. Multiskinned walls, doors, and openings can be positioned and modified; wall intersections and blanking-off are automatic; and more.

*Source Language:* FORTRAN

*Price Range:* FL.17.500

*Contact:* Ing. R. A. Peterse, 31 2990 55555

## ▪ **Manufacturing Control—Product Manufacturing**

### ▪ *AIM-Supervisor*<sup>TM</sup>

Biles & Associates 6161 Savoy Drive  
Suite 500  
Houston, TX 77036

AIM-Supervisor allows users of distributed instrumentation systems and programmable controllers to perform continuous or batch process management, historical data management, statistical process control, and more.

*Source Language:* FORTRAN-77

*Price Range:* \$30,000

*Contact:* Fred W. Woolfrey, (713) 789-8880

### ▪ *Bravo3® Facilities Layout*<sup>TM</sup>

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

Facilities Layout handles the design, layout, and ongoing maintenance of a graphics model of a manufacturing facility and its equipment. It supports large facilities of up to several miles in area.

*Source Language:* Pascal

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

• *CAEMIS® (Computer Aided Engineering/Management Information Services)*

Impell Corporation  
333 Research Court  
Norcross, GA 30092

CAEMIS consists of software applications for facility, piping, structural, electrical, or process engineering, which can be used individually or as an integrated set. The graphics editor contains ANSI and IEEE components.

*Price Range:* \$5,000–\$17,500

*Contact:* C. Clark McDonald, (404) 441-5166

• *MAP/1™ (Modeling and Analysis Program)*

Pritsker & Associates, Inc.  
8910 Purdue Road  
Suite 500  
Indianapolis, IN 46468

MAP/1 is a manufacturing simulator designed for modeling discrete manufacturing systems. It includes predefined symbols for conveyors, fixtures, stations, and operators and an interactive model building system.

*Source Language:* FORTRAN

*Price Range:* \$10,500–\$19,500

*Contact:* David Isles, (317) 879-1011

- **PDMS**

CADCentre Ltd.  
High Cross  
Madingley Road  
Cambridge CB3 0HB  
England, United Kingdom

PDMS is a package for the creation of three-dimensional models of complex plants. It is structured for coordinated work by teams of designers. Once created, models can be viewed from any angle.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Tom Brown, (713) 977-1225

- **TESS™ (The Extended Simulation System)**

Pritsker & Associates, Inc.  
8910 Purdue Road  
Suite 500  
Indianapolis, IN 46468

TESS is an integrated simulation environment built around a relational database management system. It stores and organizes data and supports data acquisition, model building, validation and verification, and animations.

*Source Language:* FORTRAN

*Price Range:* \$22,500-\$44,000

*Contact:* David Isles, (317) 879-1011

- **Factory Automation**

- **EC\_BATCH NC Programming System**

Adra Systems, Inc.  
59 Technology Drive  
Lowell, MA 01851



This NC programming compiler processes APT part files, part programs, and tool paths. It handles sophisticated part surfaces, checks multiple part surfaces for gouging, creates paperless documentation, and more.

*Source Language:* C, FORTRAN, Pascal

*Price Range:* \$7,000-\$65,000

*Contact:* Arie Niv, (508) 937-3700

▪ *Optipart™*

Optimization, Inc.

2801 East Missouri

Suite 17

Las Cruces, NM 88001

Optipart is a CAD graphics part programming companion to Optinest and Optipunch. The user constructs an NC part by entering data through a menu-driven graphics format. It is aimed at small to medium-sized manufacturers.

*Source Language:* FORTRAN-77

*Price Range:* \$10,000-\$18,000

*Contact:* Anwar Hassan, (505) 522-3303

▪ *Optirout™*

Optimization, Inc.

2801 East Missouri

Suite 17

Las Cruces, NM 88001

Optirout is an automatic nesting system for NC routers with drilling and riveting spindles. It offers interactive graphics and business and CAD/CAM interfaces. Optirout includes several management reports.

*Source Language:* FORTRAN-77

*Price Range:* \$80,000-\$200,000

*Contact:* Anwar Hassan, (505) 522-3303

## • Manufacturing Control—Product Manufacturing

### • *Bravo3® Bravo NC™*

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

Bravo NC creates multiple paths over the surfaces of a part model by creating a lattice of all possible tool positions and eliminating all but legitimate cases. It handles gouge checking and generates tool path motions.

*Source Language:* Pascal

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

### • *Bravo3® EDM™*

Schlumberger Technologies CAD/CAM Division  
4251 Plymouth Road  
P. O. Box 986  
Ann Arbor, MI 48106-0986

EDM is a programming system that offers 3D graphics with an interface that is designed specifically for programming tilting-wire EDM machines. It accepts geometric data, graphics, and machine tool drivers.

*Source Language:* Pascal

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

### • *CAM-APT-SURF®*

ICAM Technologies Corporation  
1900 Sources Boulevard  
Pointe Claire  
Quebec H9R 4Z3, Canada

CAM-APT-SURF processes sculptured surfaces and handles APT programs for machining applications covering a variety of geometric surfaces. This system was designed for use in the aerospace and automotive industries.

*Source Language:* FORTRAN, MACRO-32

*Price Range:* \$5,290-\$26,800

*Contact:* Brian Francis, (514) 697-8033

• CAM-FIVE-S®

ICAM Technologies Corporation

1900 Sources Boulevard

Pointe Claire

Quebec H9R 4Z3, Canada

CAM-FIVE-S teaches APT programming and allows each user to program and verify parts for any NC/CNC machine/control combination and covers nonanalytical 3D, sculptured, and conventional geometric surfaces.

*Source Language:* FORTRAN

*Price Range:* \$21,938-\$48,263

*Contact:* John J. Nassr, Jr., (514) 697-8033

• CAM-PLOT®

ICAM Technologies Corporation

1900 Sources Boulevard

Pointe Claire

Quebec H9R 4Z3, Canada

CAM-PLOT is an interactive, numerical control, tool path graphic processor used as an NC part program simulation and debugging utility. It verifies accuracy of programmed feed rates and tool path motions.

*Source Language:* FORTRAN

*Price Range:* \$2,750-\$5,425

*Contact:* John Carlin, (514) 697-8033



- **CAM-POST®**

ICAM Technologies Corporation  
1900 Sources Boulevard  
Pointe Claire  
Quebec H9R 4Z3, Canada

CAM POST produces and maintains postprocessors for most NC/CNC machine tool/control combinations, from lathes to five-axis continuous path machines usable with any CAD/CAM system providing standard CL file data.

*Source Language:* FORTRAN

*Price Range:* \$10,350-\$32,400

*Contact:* John Carlin, (514) 697-8033

- **NCL-CAM501™**

Numerical Control Computer Sciences  
17321 Murphy Avenue  
Irvine, CA 92714

NCL-CAM501 is a color graphics package for 2-5 axis machining. It includes 3D sculptured surfaces and multiaxis tool control. Users can interact with the system in 3-window, full graphic, or batch processing modes.

*Source Language:* FORTRAN, C

*Price Range:* Available upon request

*Contact:* Ernest Dias D'Leon, (714) 474-7444

- **VXL™**

Control Systems International  
8826 Santa Fe Drive  
Suite 100  
Overland Park, KS 66212

VXL transforms a VAXstation into a user-configurable cell controller with high resolution color graphic operator interface. Features include a video signal processor, report generation, archiving, operator interface, and more.

*Source Language:* C

*Price Range:* \$3,000-\$30,000

*Contact:* Ann Flynn, (913) 642-2900

▪ **Specialized Manufacturing Systems**

▪ *Bravo3® Sheet Metal Design and Fabrication™*

Schlumberger Technologies CAD/CAM Division

4251 Plymouth Road

P. O. Box 986

Ann Arbor, MI 48106-0986

This sheet metal design and fabrication product is used to design sheet metal parts and program NC machine tools. It has a built-in, 3D modeler, can run standalone, and integrates with Bravo3 CAD products.

*Source Language:* Pascal

*Price Range:* Available upon request

*Contact:* Patrice E. Romzick, (313) 995-6718

▪ *Optipunch™*

Optimation, Inc.

2801 East Missouri

Suite 17

Las Cruces, NM 88001

Optipunch is an automatic nesting system for NC punch presses, either standalone or in combination with laser, plasma, or right angle shear. It offers interactive graphics and automatic business and CAD/CAM interfaces.

*Source Language:* FORTRAN-77

*Price Range:* \$50,000-\$100,000

*Contact:* Anwar Hassan, (505) 522-3303

- **SMP-81 (Sheet Metal Program)**

Merry Mechanization  
5360 Viking Boulevard East  
P. O. Box 307  
Wyoming, MN 55092

SMP-81, a CAD/CAM package for sheet metal fabricators, calculates flat layouts and develops NC punch programs. It is an interactive, graphical package that may be used alone or with general-purpose CAM/CAM software.

*Source Language:* FORTRAN-77

*Price Range:* \$159,000

*Contact:* James W. Vincent, (612) 462-2124

- **Office Automation**

- **Document Storage—Retrieval—Indexing**

- **KIMS (Kodak Information Management Systems)**

Eastman Kodak Company  
Business Systems Imaging  
Division  
343 State Street  
Rochester, NY 14560

KIMS is a computer-based image document management system for electronic publishing. It digitizes and stores document images for quick retrieval. KIMS includes multi-function workstations.

*Source Language:* Pascal

*Price Range:* \$198,000–\$2,000,000

*Contact:* David Yelton, (716) 726-1808



▪ **Typesetting—Laser Printer Output**

▪ **Interleaf™ Workstation Publishing Software**

Digital Equipment Corporation  
146 Main Street  
Maynard, MA 01754-2571

This product is an office productivity tool that enables a single user to prepare and edit documents containing multiple typefaces and a wide range of graphics. It includes graphics editing, business charts, and more.

*Price Range:* Available upon request

*Contact:* Consult your local Digital Sales Office.

▪ **Research—By Discipline**

▪ **Artificial Intelligence Research**

▪ **NEXPERT OBJECT™**

Digital Equipment Corporation  
146 Main Street  
Maynard, MA 01754-2571

NEXPERT OBJECT is a graphical-knowledge management tool that integrates knowledge representation methodologies with inferencing mechanisms. The user interface uses color, windows, and graphic networks.

*Source Language:* C

*Price Range:* Available upon request

*Contact:* Consult your local Digital Sales Office.

- **Chemistry Research**

- **ACCESS\*CHROM™**

Nelson Analytical, Inc.  
10040 Bubb Road  
Cupertino, CA 95014

ACCESS\*CHROM is a chromatography data acquisition and processing package that analyzes and stores data from LC, GC, and HPLC chromatographs. It allows graphic re-analysis of stored runs and postrun reprocessing.

*Source Language:* Pascal

*Price Range:* \$15,000–\$45,000

*Contact:* Lynn Board, (408) 725-1107

- **BIOGRAPH and POLYGRAPH**

BioDesign, Inc.  
199 S. Los Robles Avenue  
Suite 270  
Pasadena, CA 91101

BIOGRAPH and POLYGRAPH are molecular design and simulation programs with interactive 3D graphics and molecular mechanics for real-time simulation, standard force fields, and customized builders.

*Source Language:* FORTRAN

*Price Range:* \$36,000–\$150,000

*Contact:* Jeffrey R. Marusin, (818) 793-0151

- **CENTRUM™ Research Information System**

Polygen Corporation  
200 Fifth Avenue  
Waltham, MA 02254

This research information system provides document-based access to corporatewide technical database resources. It in-

tegrates text, data, graphics, and chemical structures into chemical research documents.

*Source Language:* C

*Price Range:* \$4,000-\$48,000

*Contact:* Chris Mrowka, (617) 890-2888

• *Chem-X*

Chemical Design Ltd.

Unit 12

7 West Way

Oxford OX2 0JB

England, United Kingdom

Chem-X is an integrated series of programs for molecular modeling. It provides 3D structure building, manipulation and display functionality, and calculation facilities.

*Source Language:* FORTRAN-77

*Price Range:* £12,000-£70,000

*Contact:* Keith Taylor, 44 865 251483

• *CHEMLAB-II*

Molecular Design Ltd.

2132 Farallon Drive

San Leandro, CA 94577

CHEMLAB is an interactive system for chemical modeling. It integrates molecular modeling, conformational analysis, and molecular descriptor generation. The package includes molecular processing tools and more.

*Source Language:* FORTRAN

*Price Range:* \$60,000-\$90,000

*Contact:* Thomas Jones, (415) 895-1313



- **DISCOVER™**

BIOSYM Technologies, Inc.  
10065 Barnes Canyon Road  
Suite A  
San Diego, CA 92121

This molecular simulation program for applications in computer-assisted molecular design incorporates molecular mechanics and dynamics algorithms and methodologies that have a demonstrated applicability to drug design.

*Price Range:* \$4,500–\$125,000

*Contact:* Christine Sheppard, (619) 458-9990

- **Insight™**

BIOSYM Technologies, Inc.  
10065 Barnes Canyon Road  
Suite A  
San Diego, CA 92121

This general-purpose, 3D, real-time molecular modeling program selectively displays and manipulates molecules and their components. It has no preset limit on the number of atoms, residues, or molecules that can be displayed.

*Source Language:* C

*Price Range:* \$6,000–\$60,000

*Contact:* Christine Sheppard, (619) 458-9990

- **MACCS™-II (Molecular Access System)**

Molecular Design Ltd.  
2132 Farallon Drive  
San Leandro, CA 94577

MACCS-II, a chemical information management system, includes the fine chemicals directory with supplier information. Chemical structures and related information are stored and accessed using graphical input.

*Source Language:* FORTRAN

*Price Range:* \$40,000-\$300,000

*Contact:* Thomas Jones, (415) 895-1313

▪ *NIC-COM/IR*

Nicolet Instrument Corporation

5225-1 Verona Road

Madison, WI 53711

NIC-COM/IR transfers infrared spectral information between a Nicolet spectrometer and a VAX or VAXcluster system, offers error detection and correction, and supports communication protocols and terminal emulation mode.

*Source Language:* FORTRAN, MACRO

*Price Range:* \$1,500-\$2,500

*Contact:* Susan K. Byram, (608) 271-3333

▪ *QUANTA™*

Polygen Corporation

200 Fifth Avenue

Waltham, MA 02254

QUANTA is a molecular modeling and graphical analysis system that displays, manipulates, analyzes, compares, and builds three-dimensional molecular models in real time.

*Source Language:* FORTRAN, C

*Price Range:* \$1,500-\$40,000

*Contact:* Chris Mrowka, (617) 890-2888

▪ *REACCS™ (Reaction Access System)*

Molecular Design Ltd.

2132 Farallon Drive

San Leandro, CA 94577

REACCS, a reaction access system, stores molecules and reactions with associated data. Structures are searched and displayed graphically. User-defined data types may be searched with or without structures.

*Source Language:* FORTRAN

*Price Range:* \$30,000-\$200,000

*Contact:* Thomas Jones, (415) 895-1313

▪ **Computational Fluid Dynamics**

▪ **FIDAP™** (*Fluid Dynamics Analysis Package*)

Fluid Dynamics International, Inc.

1600 Orrington Avenue

Suite 400

Evanston, IL 60201

FIDAP uses the finite-element method to simulate classes of incompressible fluid flows in complex geometries. It provides a range of possible analyses such as isothermal, turbulent, convection, thermal, and creeping flows.

*Source Language:* FORTRAN

*Price Range:* \$9,000-\$22,000

*Contact:* Michael Engelman, (312) 491-0200

▪ **FLUENT®**

Creare, Inc.

Etna Road

P. O. Box 71

Hanover, NH 03755

FLUENT is general-purpose CFD software that models fluid flow, heat transfer, and combustion. It solves the steady-state and transient Navier-Stokes equations using the finite volume method in 2- or 3D geometries.

*Source Language:* FORTRAN-77

*Price Range:* Available upon request

*Contact:* Zahed Sheik, (603) 643-3800



• **FLUENT/BFC®**

Creare, Inc.  
Etna Road  
P. O. Box 71  
Hanover, NH 03755

FLUENT/BFC is general-purpose CFD software that models fluid flow and heat transfer. It contains geometry modeling, grid generation, and graphics. It models 2- and 3D flows with a variety of boundary conditions.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Zahed Sheik, (603) 643-3800

• **PHOENICS™**

CHAM of North America  
1525-A Sparkman Drive  
Huntsville, AL 35816

PHOENICS is a general-purpose computational fluid dynamics program for the simulation of fluid flow, heat transfer, mass transfer, and chemical reaction processes. It is used in the aerospace, marine, and other industries.

*Source Language:* FORTRAN-77

*Price Range:* \$5,500-\$170,000

*Contact:* Mike Nieburg, (205) 830-2620

• **Signal Processing**

• **ILS® (Interactive Laboratory System)**

Signal Technology, Inc.  
5951 Encina Road  
Goleta, CA 93117

ILS is an integrated set of interactive signal processing programs. It analyzes noise and vibration, speech, biomedical,

acoustic, and radar signals. It offers multiwindows and color graphics.

*Source Language:* FORTRAN

*Price Range:* \$5,100-\$198,000

*Contact:* Rod Jensen, (805) 683-3771

## • Visualization

### • DI-3000 XPM™

Precision Visuals, Inc.

6260 Lookout Road

Boulder, CO 80301

DI-3000 XPM, a tool for creating 2D or 3D graphics applications ranging from simple data display to hierarchical graphics data management, is used for manufacturing simulation, facilities layout, molecular modeling, and more.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Chris Logan, (303) 530-9000

### • DI-TEXTPRO®

Precision Visuals, Inc.

6260 Lookout Road

Boulder, CO 80301

DI-TEXTPRO produces text of any size and color in 24 different typefaces. It includes automatic superscripts, subscripts, 2D and 3D text, underlining, context-dependent character spacing, and more.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Chris Logan, (303) 530-9000

▪ **DV-Draw™**

V. I. Corporation  
Amherst Research Park  
Amherst, MA 01002

This menu-driven drawing editor analyzes and monitors dynamic data. It enables users to create, without programming, 2D static and dynamic drawings such as schematics, control systems, and instrument panels.

*Source Language:* C

*Price Range:* \$28,910

*Contact:* Roger Howard, (413) 253-3482

▪ **IDL (Interactive Data Language)**

Research Systems, Inc.  
2021 Albion Street  
Denver, CO 80207

IDL analyzes, reduces, and displays scientific and engineering data. IDL combines self-describing, array-oriented data sets, operators, functions, and graphical and image display capabilities to form an interactive system.

*Source Language:* FORTRAN, MACRO-32, C

*Price Range:* \$3,000–\$8,000

*Contact:* David M. Stern, (303) 399-1326

▪ **PV-WAVE™**

Precision Visuals, Inc.  
6260 Lookout Road  
Boulder, CO 80301

PV-WAVE is a fully integrated, interactive data analysis system for reducing, analyzing, and displaying large, multi-dimensional data sets. The system enables rapid visualization of data—262,000 data points from disk to display in less than 3 seconds.



*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* David Prawell, (303) 530-9000

## ▪ Sales—Marketing—Service

### ▪ Advertising

#### ▪ *The NYNEX Market Connection*

NYNEX Computer Services Company  
2 Blue Hill Plaza  
First Floor  
Pearl River, NY 10965

This interactive presentation system enables companies to communicate with the marketplace to promote, advertise, or provide product information. It uses varied media to promote products and services.

*Source Language:* C

*Price Range:* \$12,000–\$25,000

*Contact:* Marc Maltz, (914) 620-5207

## ▪ Software Development

### ▪ Software Development—Programming Aids

#### ▪ *Enter/Act™*

Precision Visuals, Inc.  
6260 Lookout Road  
Boulder, CO 80301

Enter/Act is a user-interface management system that handles aspects of the user/computer interface, including prompt and command interaction, menus, data entry, and window management for alphanumeric and graphics terminals.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Chris Logan, (303) 530-9000

▪ *PROSA Structured Analysis Tool*

Insoft Ky

Kirkkokatu 5 B

SF-90100 Oulu

Finland

This computer-aided SA/RT tool helps systems analysts and software designers visualize, specify, and manage system and software development projects. It describes applications with three integrated models.

*Source Language:* C

*Price Range:* \$7,000

*Contact:* Mikko Tervonen, 358 81 226128

▪ **Programming Languages—Compilers**

▪ *PowerHouse®*

Cognos, Inc.

3755 Riverside Drive

P. O. Box 9707

Ottawa

Ontario K1G 3Z4, Canada

This 4GL product consists of three integrated processors and a data dictionary. It includes online and volume transaction processing, data forms and menus, and data reporting and formatting.

*Source Language:* C

*Price Range:* \$1,250-\$187,550

*Contact:* Pierre Viau, (613) 738-1440

## ▪ Specialized Application Tools

### ▪ *Eiffel*<sup>TM</sup>

Interactive Software Engineering, Inc.

270 Storke Rd.

Suite 7

Goleta, CA 93117

Eiffel is an object-oriented design and programming language and environment for producing high quality software in industrial environments. The language supports multiple inheritance, dynamic binding, static typing, assertions, exceptions, etc. The environment offers automatic recompilation, documentation, garbage collection, debugging and graphical design. Cross-development from Eiffel to C is supported, allowing the production of stand-alone C packages.

*Price Range:* Available upon request

*Contact:* Annie Meyer, (805) 685-1006

### ▪ *ENTERPRISE: BUILDER/VMS*<sup>TM</sup> *ENTERPRISE: GENERATOR/VMS*<sup>TM</sup> *ENTERPRISE: EXPERT/VMS*<sup>TM</sup>

Cullinet Software, Inc.

400 Blue Hill Drive

Westwood, MA 02090

Three integrated tools for commercial application development. EXPERT helps build inference-based and voice-response systems; BUILDER is a set of 4GL-like tools; and GENERATOR produces optimized 3GL code from BUILDER output.

*Source Language:* C

*Price Range:* Available upon request

*Contact:* Bill McLaughlin or John Rogers, (617) 329-7700



▪ **EXCELERATOR®**

Index Technology Corporation  
One Main Street  
Cambridge, MA 02142

EXCELERATOR is a CASE product for systems analysis, design, and documentation in one environment. It automates the early phases in the software development life cycle and lets analysts estimate the impact of changes.

*Source Language:* C

*Price Range:* \$6,100-\$8,400

*Contact:* (617) 494-8244

▪ **MANTIS™**

Cincom Systems, Inc.  
2300 Montana Avenue  
Cincinnati, OH 45211

MANTIS is a fourth-generation application development system designed for large MIS departments. It provides access to multiple data structuring techniques, including database management files.

*Source Language:* COBOL and Assembly

*Price Range:* \$8,000-\$38,000

*Contact:* Sales Contact, (800) 543-3010

▪ **KEE (Knowledge Engineering Environment)**

Intellicorp  
1975 El Camino Real West  
Mountain View, CA 94040-2216

KEE is a knowledge management tool that helps system and application developers build expert systems. It offers a frame language as well as reasoning and analysis, interface construction, and integration facilities.

*Price Range:* \$30,000

- **PICture™**

Interactive Development Environments, Inc.  
595 Market Street  
Twelfth Floor  
San Francisco, CA 94103

PICture is an object-oriented, interactive tool for drawing pictorial diagrams. It supports symbols used in software and database design, and features symbol connection and translation, visible and hidden text, and more.

*Price Range:* \$1,500

*Contact:* Sandra Golez, (415) 543-0900

- **POPLOG**

Systems Designers PLC  
AI Business Centre  
Pembroke House  
Pembroke Broadway  
Camberley  
Surrey GU15 3XD  
England, United Kingdom

POPLOG is an interactive, multiparadigm development environment for artificial intelligence and rapid prototyping. It allows developers to combine LISP, PROLOG, and POP-11 within a single program.

*Source Language:* POP-11, C

*Price Range:* £7,500-£18,000

*Contact:* Dr. T. Alan Montgomery, 44 276 686200

- **SMARTSTAR®**

Signal Technology, Inc.  
5951 Encina Road  
Goleta, CA 93117

SMARTSTAR, an application development and information management system, provides 4GL application generation

and reporting facilities for end users and SQL development tools for sophisticated users and MIS/DP professionals.

*Source Language:* BASIC, C, machine language

*Price Range:* \$3,500–\$55,000

*Contact:* Gregory Karpain, (805) 683-3771

▪ *Software through Pictures™*

Interactive Development Environments, Inc.

595 Market Street

Twelfth Floor

San Francisco, CA 94103

This product provides graphics editors that support structured analysis and design techniques for computer-aided software engineering. It includes data modeling, entity-relationship modeling, data structure design, and more.

*Source Language:* C

*Price Range:* \$1,500–\$25,000

*Contact:* Irene G. Kazakova, (415) 543-0900

▪ *Software through Pictures™/Real-Time Extensions*

Interactive Development Environments, Inc.

595 Market Street

Twelfth Floor

San Francisco, CA 94103

This product is a set of tools for software analysis of real-time systems. It is integrated with the Structured Analysis product, and includes two additional graphical editors, a table editor, and the IDE Data Dictionary.

*Source Language:* C

*Price Range:* \$11,000–\$21,000

*Contact:* Sandra Golez, (415) 543-0900



- *Software through Pictures™/Structured Analysis*

Interactive Development Environments, Inc.  
595 Market Street  
Twelfth Floor  
San Francisco, CA 94103

This product provides an integrated environment and a set of tools for software analysis. It features graphical editors, an interface to the IDE Data Dictionary, checking programs, and customizable tools and menus.

*Source Language:* C

*Price Range:* \$7,000

*Contact:* Sandra Golez, (415) 543-0900

- *Software through Pictures™/Structured Design*

Interactive Development Environments, Inc.  
595 Market Street  
Twelfth Floor  
San Francisco, CA 94103

This product provides an integrated environment and a set of tools that support the systems design process. It includes graphical editors, the IDE Data Dictionary, checking programs, an extensible front-end menu, and more.

*Source Language:* C

*Price Range:* \$5,000

*Contact:* Sandra Golez, (415) 543-0900

- *Software through Pictures™/User Software*

Engineering  
Interactive Development Environments, Inc.  
595 Market Street  
Twelfth Floor  
San Francisco, CA 94103

This product provides an integrated environment and a set of tools for prototyping and development of interactive in-

formation systems, particularly applications that involve conversational access to a database.

*Source Language:* C

*Price Range:* \$7,000

*Contact:* Sandra Golez, (415) 543-0900

• **SUPRA®**

Technology Modeling Associates, Inc.

300 Hamilton Avenue

Third Floor

Palo Alto, CA 94301

SUPRA simulates fabrication processes for nonplanar MOS and bipolar devices. It models a variety of device structures composed of as many as 8 implantation masking layers. This version offers additional enhancements.

*Source Language:* FORTRAN

*Price Range:* Available upon request

*Contact:* Robin L. Cole, (415) 327-6300

• **TEAMWORK®**

Cadre Technologies, Inc.

222 Richmond St.

Providence, RI 02903

TEAMWORK provides state-of-the-art, front end analysis, design tools, and the environment for complete system development.

*Source Language:* C

*Price Range:* \$2,000-\$10,000

*Contact:* Jim McDonough, (401) 351-5950

- **Systems Software—System Utilities**

- **Performance Monitor—Tuning Aids**

- **GPSM™** (*Graphical Programming of Simulation Models*)

Information Research Associates  
911 West 29th Street  
Austin, TX 78705

GPSM is a graphical front end to PAWS (Performance Analyst's Workbench System). It allows the modeler to build simulation models as annotated graphs and manipulates them by pointing to various elements using a mouse.

*Source Language:* Pascal

*Price Range:* \$2,500–\$12,000

*Contact:* Doug Neuse, (512) 474-4526



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## **Appendix A • Vendor International Distributors—Sales Offices**

### **AEG Software-Technik**

*Application Name:* RUPLAN®

*TECHNODAT Technische Datenverarbeitung GmbH*

Linzergerasse 55

A-5020 Salzburg

Österreich

*GEI Software-Technik GmbH & Company KG*

Hohenzollerndamm 150

1000 Berlin 33

West Germany

### **Auto-trol Technology Corporation**

*Application Name:* Series 5000

*Application Name:* Series 7000

*Auto-trol Technology Corporation*

100 Miller Street

North Sydney NSW 2060

Australia

### **BIOSYM Technologies, Inc.**

*Application Name:* DISCOVER

*Application Name:* INSIGHT

*BIOSYM Technologies GmbH*

Schatzbogen 54

8000 Munich 82

West Germany

**BIOSYM Technologies**  
Marlborough House  
Hartley Wintney  
Basingstoke  
Hants RG27 8NY  
England, United Kingdom

**Cincom Systems, Inc.**

*Application Name:* MANTIS

*Cincom Systems International SA*  
Buizerdlaan 2  
3435 SB Nieuwegein  
Netherlands

*Cincom Systems of Australia Pty. Ltd.*  
486 Pacific Highway  
St. Leonards  
Sydney NSW 2065  
Australia

**CIS Medusa, Inc.**

*Application Name:* CIS Medusa™

*Computervision Medusa*  
Harston Mill  
Royston Road  
Harston  
Cambridge CB2 5NL  
England, United Kingdom

**Cisigraph**

*Application Name:* PROCOP™

*Cisigraph Benelux*  
Europalaan 101  
3526 KR Utrecht  
Netherlands



*Cisigraph Corporation*  
 33533 West 12 Mile Road  
 Suite 100  
 Farmington Hills, MI 48331

*Cisigraph GmbH*  
 Seidlstrasse 30  
 8000 Munchen 2  
 West Germany

*Cisigraph Canada, Inc.*  
 6500 Route Trans-Canadienne  
 Suite 208  
 St. Laurent  
 Quebec H4T 1X4, Canada

**Cognos, Inc.**

*Application Name:* PowerHouse®

*Calidus Systems Ltd.*  
 79-83 Great Portland Street  
 London WIN 5RA  
 England, United Kingdom

*Cognos Ltd.*  
 Westerly Point  
 Market Street  
 Bracknell, Berkshire RG12 1QB England, United Kingdom

*Cognos Pty. Ltd.*  
 118-120 Pacific Highway  
 St. Leonards NSW 2065  
 Australia

*Commercial Data Processing Ltd.*  
 Hume House  
 152 The Terrace  
 Wellington  
 New Zealand

**SIS Datenverarbeitung GmbH**

Reithlegasse 4  
A-1190 Wien  
Osterreich

**Waterland automatisering BV**

Gorslaan 10  
1441 RG Purmerend  
Netherlands

**Digital Equipment Corporation**

*Application Name:* AutoCAD® for VAXstation

**Autodesk, Inc.**

2320 Marinship Way  
Sausalito, CA 94965

**Teser Holland BV**

Spuiboulevard 314  
3311 GR Dordrecht  
Netherlands

**Autodesk Ltd.**

South Bank Technopark  
90 London Road  
London SE1 6LN  
England, United Kingdom

**Moor W. Data GmbH**

Lamzanstrasse 10  
A-1232 Vienna  
Austria

**CAD Service BVBA**

Leo de Bethunelaan 51  
B-9300 Aalst  
Belgium

**CGE Composant**

32, rue Chateau des Rentiers  
F-92360 Meudon-la-Forêt  
France

**FABRIS AG Computerlösungen f. Industrie und Handel**  
Joseph-Dollinger-Bogen 7  
8000 München 40  
West Germany

**Northern Systems Ltd.**  
The CAD/CAM Centre  
Riverside Park  
Middlesbrough  
Cleveland TS2 1RJ  
England, United Kingdom

**Digital Equipment Corporation**

**Application Name:** Interleaf™ Workstation Publishing Software

**Interleaf, Inc.**  
10 Canal Park  
Cambridge, MA 02141

**Interleaf (U.K.) Ltd.**  
Interleaf House  
204-212 Shepherds Bush Road  
Hammersmith  
London W6 7NL  
England, United Kingdom

**Interleaf France**  
Le Michelet  
6, cours Michelet  
92064 Paris  
France

**Interleaf Belgium**  
Ter Hulpse Steenweg 130  
1050 Brussels  
Belgium

**Interleaf GmbH**  
Leopoldstraße 28A  
8000 München  
West Germany



**Interleaf Canada**

100 Alexis Nihon Road  
Suite 875  
St. Laurent  
Quebec H4M 2P4, Canada

**Delairco Publishing Solutions Pty. Ltd.**

12 Barcoo Street  
Roseville NSW 2069  
Australia

**Dynamic Graphics, Inc.**

*Application Name:* ISM™

*Application Name:* SLP™

**Dynamic Graphics (U.K.) Ltd.**

Addison-Wesley Building  
Finchampstead Road  
Wokingham  
Berkshire RG11 2NZ  
England, United Kingdom

**GE Calma**

*Application Name:* Dimension III™

**GE Calma**

Prinz Eugen Straße 8-10  
A-1040 Wien  
Österreich

*Application Name:* Prism/DDM™

**GE Calma**

Prinz Eugen Straße 8-10  
A-1040 Wien  
Österreich

*GE Calma*  
 Beech House  
 373-399 London Road  
 Camberley  
 Surrey GU15 3HR  
 England, United Kingdom

**Harris/Scientific Calculations, Inc.**

*Application Name:* SCICARDS®

*Harris GmbH*  
 2 Haberstraße  
 5210 Troisdorf 14  
 West Germany

**Insignia Solutions Ltd.**

*Application Name:* SoftPC™

*Insignia Solutions Ltd.*  
 Carrington House  
 Oxford Road  
 High Wycombe  
 Buckinghamshire  
 HP11 2EG  
 England  
 Contact: Ivor Share, (44) 494-459426

**The MathWorks, Inc.**

*Application Name:* MATLAB™

*MGA, Inc.*  
 73 Junction Square Drive  
 Concord, MA 01742

**Matra Datavision, Inc.**

*Application Name:* EUCLID®-IS

*TECHNODAT Technische Datenverarbeitung GmbH*  
 Linzergasse 55  
 A-5020 Salzburg  
 Österreich

***Matra Datavision (U.K.) Ltd.***

Queen's House  
Queen's Road  
Coventry CV1 3HY  
England, United Kingdom

***Matra Datavision Pty. Ltd.***

Innovation House  
Technology Park Adelaide  
Adelaide SA 5095  
Australia

***Matra Datavision***

Schatzbogen 62  
8000 München  
West Germany

**McDonnell Douglas Built Environment Technologies**

***Application Name: GDS***

***ARC CADcentre Pty. Ltd.***

361 Kent Street  
Level 1  
Sydney NSW 2000  
Australia

***SUTER + SUTER GmbH Design Systems***

Otto Bauergasse 6  
A-1060 Wien  
Österreich

***McDonnell Douglas Information Systems Ltd.***

McDonnell Douglas Computer Systems Co.  
Boundary Way  
Hemel Hempstead  
Hertfordshire HP2 7HU  
England, United Kingdom



*Data Process Informatica NV*  
Division Data Process Techformatica  
Amsterdamseweg 41  
3812 RP Amersfoort  
Netherlands

**McDonnell Douglas Mfg. & Eng. Systems Company**

*Application Name:* UNIGRAPHICS®

*VOEST-ALPINE AG, Geschäftsfeld AIS*  
Strasserau 6  
Postfach 22  
A-4020 Linz  
Österreich

*McDonnell Douglas Information Systems BV*  
Koningin Julianaplein 30.A4  
2595 AA Den Haag  
Netherlands

**Molecular Design Ltd.**

*Application Name:* REACCS™

*Molecular Design Ltd.*  
Saphire Court  
274-276 High Street  
Slough  
Berkshire  
England, United Kingdom

**Oracle Corporation**

*Application Name:* ORACLE®

*Datacom Systems Ltd.*  
125 Albert Street  
P.O. Box 6041  
Auckland  
New Zealand

**ORACLE Deutschland GmbH**  
Forstenrieder Allee 61  
D-Munchen 71  
West Germany

**Precision Visuals, Inc.**

*Application Name:* DI-3000®

*Precision Visuals*  
Lyoner Stern  
Hahnstrasse 70  
D-6000 Frankfurt/Main 71  
West Germany

**PAFEC, Inc.**

*Application Name:* DOGS

*Waterland Automatisering BV*  
Gorslaan 10  
1441 RG Purmerend  
Netherlands

*BV Ingenieursbureau H.E.C.*  
Prins Bernardlaan 10  
2405 VT Alphen A/D Rijn  
Netherlands

*Rotring EuroCAD GmbH*  
Schnackenburgallee 41  
D-2000 Hamburg 54  
West Germany

*Application Name:* PAFEC

*BV Ingenieursbureau H.E.C.*  
Prins Bernardlaan 10  
2405 VT Alphen A/D Rijn  
Netherlands

**PDA Engineering**

*Application Name:* The PATRAN System™

*PDA Engineering International GmbH*

Steinsdorfstraße 14

8000 München 22

West Germany

*Compumod Pty. Ltd.*

20 Martin Place

10th Floor

Sydney NSW 2000

Australia

**Racal-Redac, Inc.**

*Application Name:* VISULA PLUS™

*Racal-Redac-Design-System GmbH*

Muthmannstraße 4

8000 München 45

West Germany

**SDRC, Inc.**

*Application Name:* I-DEAS™

*SDRC CAE International*

Gunnels Wood House

Gunnels Wood Road

Stevenage

Herts SG1 9DY

England, United Kingdom

**Synercom Technology, Inc.**

*Application Name:* INFORMAP III™

*Laser-Scan Laboratories Ltd.*

Cambridge Science Park

Milton Road

Cambridge CB4 4FY

England, United Kingdom



**Verhaar-Uniad Software Engineering**  
Canadalaan 1  
9731 EA Groningen  
Netherlands

**Application Name:** EMIST™

**Laser-Scan Laboratories Ltd.**  
Cambridge Science Park  
Milton Road  
Cambridge CB4 4FY  
England, United Kingdom

## **Appendix B • Traditional Products**

This appendix describes VAXstation products that are no longer sold but are still supported by Digital.

### **• Traditional VAXstation Workstations**

The following workstations continue to be supported by Digital but are no longer sold.

- VAXstation II
- VAXstation II/GPX
- VAXstation 8000

### **• VAXstation Family Features**

The major features supported by each VAXstation are listed in Table B-1. The VAXstation II and VAXstation II/GPX were based on a MicroVAX II, Digital's chip implementation of the VAX architecture. The VAXstation 8000 was based on the VAX 8250.

**Table B-1 • Traditional Product Features**

<b>VAXstation</b>	<b>II</b>	<b>II/GPX</b>	<b>8000</b>
<b>System Display</b>			
Monochrome	Yes	—	—
Gray-scale	—	Yes	—
Colors	—	Yes	Yes
Max. simultaneous colors	—	256	16 million
<b>Monitor Size/Type</b>			
19-inch color VR290	Yes	Yes	Yes
19-inch monochrome VR260	Yes	Yes	—
<b>System Memory</b>			
Maximum	16MB	16MB	32MB
<b>Storage</b>			
diskless	Yes	Yes	—
71 Mbyte disk RD53	1-3	1-3	1-3
159 Mbyte disk RD54	1-3	1-3	1-3
205 Mbyte disk RD60	—	Yes <sup>1</sup>	—
456 Mbyte disk RA81	—	Yes <sup>2</sup>	—
<b>Removable Media</b>			
1.2 Mbyte diskette RX33	Yes	Yes	—

<sup>1</sup>Half-height disk<sup>2</sup>H9642 enclosure only



**Table B-1 (Cont'd.) • Traditional Product Features**

<b>VAXstation</b>	<b>II</b>	<b>II/GPX</b>	<b>8000</b>
<b>Removable Media</b>			
.45 Mbyte disk RX50	Yes	Yes	—
95 Mbyte tape TK50	Yes	Yes	Yes
<b>Input/Output</b>			
Serial lines/ports	Yes	Yes	Yes
Ethernet/port	Yes	Yes	Yes
Q-bus	Yes	Yes	—
BI-bus	—	—	Yes



## **Appendix C • Additional Reading and References**

The following handbooks and reference manuals provide detailed information about Digital's workstation products. Order numbers for some of the manuals are given in parentheses. To obtain a copy of any of these materials, consult a Digital sales representative or see the ordering instructions immediately after the index.

### **• Handbooks and Guidebooks**

#### **Supermicrosystems Handbook**

A description of Digital's 16-bit and 32-bit supermicrosystems. Includes the MicroVAX hardware and software components and system options.

#### **VAX Architecture Handbook**

A description of the system design attributes that are common to VAX family members. Discusses virtual addressing, data representations, instruction formats, addressing modes, interrupt schemes, and memory management.

#### **VAX Hardware Handbook**

General technical information about the VAX hardware line, including VAX processors, data storage systems and devices, and communications products.

#### **VAX/VMS Software**

A 3-volume handbook set that describes the VMS operating system, Digital Command Language, programming languages, development tools, data communications products, and information management products.



### **VAXcluster Systems Handbook**

A detailed introduction to all aspects of a VAXcluster System, including selection of processors and devices, software, and support services.

### **Digital's Networks: An Architecture with a Future**

A description of the Digital Network Architecture, network concepts, general configuration guidelines, network functions, and network management.

### **Digital's Solution to Multivendor Networking**

An overview of the hardware and software connections that let Digital's systems communicate with those of other manufacturers, primarily IBM systems.

### **The DECconnect Communications System Handbook**

A description of the individual products, packages, and services that make up the DECconnect Communications System.

### **Integrated Personal Computing Handbook**

A description of Digital's personal computing integration strategy that integrates PCs in a corporate computing network.

### **A Common Sense Guide to Network Management**

General information about implementing, designing, building, operating, and repairing the software and hardware in a DECnet network. This guide describes a common-sense level of knowledge about managing networks.

### **Terminals & Printers Handbook**

This handbook will help you choose the best terminals and printers for your application and help you use them in the most efficient and productive way.

## **Windowing Guidebook**

Provides overview information on the DECwindows program and the applications and utilities available through DECwindows to PC and workstation users.

## ▪ **Software Source Books**

### **VAX Software Source Book**

Concise descriptions of more than 2500 software products for the VAX family of computers. Products are grouped by industries and generic disciplines, and cross-indexed by product name.

### **ULTRIX Software Source Book**

A comprehensive listing of software products for the ULTRIX operating systems available on PDP-11 and VAX systems.

## ▪ **Catalogs/Buyer's Guides**

### **VAX Software Buyer's Guide**

Descriptions of VAX layered products and operating system software with ordering and licensing information.

### **VAX Systems and Options Catalog**

Descriptive, ordering, and configuration information about Digital's VAX systems, hardware options, software products, and services.

### **Networks and Communications Buyer's Guide**

Descriptive, ordering, and configuration information about Digital's network and communications hardware and software products and network services.

## ▪ User Manuals

### **MicroVMS Documentation Kit**

Manual set with comprehensive details for using the VMS operating system on a MicroVAX system, system management, and programming guidelines. (QZ001-GZ)

### **VMS Workstation Software Documentation Kit**

Manual set with comprehensive details for installing and using the VMS Workstation software, graphics programming, and device driver programming. (QLA96-GZ)

### **ULTRIX Worksystems Software Documentation Set**

Manual set with comprehensive details for installing and using the ULTRIX Worksystems Software, including the operating system, system management, graphics programming, and graphics device driver programming. The sets are VAXstation specific. (Q4X32-GZ-1.0 for VAXstation II/GPX and multiplane VAXstation 2000; QLZ32-GZ-1.0 for VAXstation II and single-plane VAXstation 2000)

## ▪ Owner's Manuals

Owner's manuals give instructions for installing, operating, and troubleshooting the individual workstation hardware components. Owner's manuals are listed below:

- **VAXstation 2000 Hardware Information Kit**  
(EK-ZNAGG-GZ)
- **Desktop-VMS Management Guide**  
(EK-259AA-OM-001)
- **Desktop-VMS Management Guide (Model 40)**  
(EK-261AA-OM-001)
- **Desktop-VMS Management Basic System Guide (Model 30)**  
(EK-259AA-UG-001)
- **Desktop-VMS Advanced System Guide (Model 30)**  
(EK-260AA-OM-001)
- **VAXstation 3100 Owner's Manual (Model 30)**  
(EK-265AA-OM-001)



- **VAXstation 3100 Owner's Manual (Model 40)**  
(EK-266AA-OM-001)
- **Site Preparation Models 30, 40, and 640QS**  
(EK-286AA-OM-001)
- **VAXstation 3100 Networking Guide**  
(EK-295AA-GD-001)
- **VAXstation 3100 Expansion Box Instruction**  
(EK-297AA-IN-001)
- **DECstation 3100 Hardware Installation Guide**  
(EK-290AA-IN-001)
- **DECstation 3100 Operator's Guide**  
(EK-302AA-OG-001)
- **DECstation 3100S Server Hardware Installation Guide** (EK-309AA-SG-001)
- **VAXstation 3200 Owner's Manual BA23 Enclosure**  
(EK-154AA-OM-001)
- **VAXstation 3500 Owner's Manual BA213 Enclosure**  
(EK-171AA-OM-001)
- **VAXstation 3520/3540 User's Guide**  
(EK-251AA-UG-001)
- **Getting Started Programming on the VAXstation 3520/3540** (EK-253-PG-001)

### **The DECconnect System General Description**

Describes the products and services of Digital's DECconnect System. It also reviews the planning and installation processes for building a comprehensive communications network. (EK-DECSY-GD-001)

### **VAXstation 2000, MicroVAX 2000, and VAXmate Network Guide**

Instructions for configuring and installing simple networks, using ThinWire Ethernet. (EK-NETAA-UG-001; included in the VAXstation 2000 Hardware Information Kit)

### **Technical Manuals/Maintenance Manuals**

Comprehensive details on the design and structure of the hardware components for users who need this information or who wish to perform self-maintenance of their hardware.

- **MicroVAX II Maintenance Kit** (ZNABX-GZ)
- **VAXstation 2000/MicroVAX 2000 Maintenance Kit** (ZNAGX-GZ-001)
- **VAXstation 3100 Maintenance Guide** (EK-285AA-MG-001)
- **VAXstation 3100 IPB** (EK-288AA-IP-001)
- **DECstation 3100 Maintenance Guide** (EK-291AA-MG-001)
- **VAXstation 3520/3540 Maintenance Guide** (EK-258AA-MG-001)

### **▪ Other**

#### **Information Sheets**

Many of Digital's hardware and software products have individual fact sheets. Ask a sales representative for availability.

#### **Insight Magazine**

News from Digital about its latest hardware and software products, applications, and services. Published 10 times a year. To be added to the mailing list, consult a salesperson or send name, title, company affiliation, and mailing address to Digital Equipment Corporation, MKO-1/W83, Continental Boulevard, Merrimack, NH 03054.

### **▪ Non-Digital Publication**

#### **Fundamentals of Interactive Computer Graphics**

J. D. Foley and A. VanDam. Reading, MA: Addison-Wesley Publishing Company, Inc., 1982.

A reference source on interactive graphics systems, including hardware, software, data structures, mathematical manipulation of graphical objects, user interface, and fundamental implementation algorithms. (This book cannot be ordered from Digital. To order this book, call 617-944-3700.)

## ▪ RISC Reading

- "The fast way to build a RISC processor." 32-bit Microprogrammable Products 1988 Databook, Advance Micro Devices, 6-92 to 6-96.
- MB86900 RISC Processor Architecture Manual. FUJITSU Microelectronics, Inc., November 1987.
- IEEE MICRO, Vol. 8 No. 2. The Computer Society, April 1988.
- IEEE MICRO, Vol. 8 No. 3. The Computer Society, June 1988.
- "Reduced Instruction Set Computer (RISC) Processors." High Performance CMOS Databook. Integrated Devices Technology, Inc., 9-1 to 9-18.
- Kane, Gerry. *MIPS R2000 RISC Architecture*, 1987.
- *RISC Technology Backgrounder*. MIPS Computer Systems, Inc., March 28, 1988.





## Appendix D • Third-Party Trademarks

ACCESS\*CHROM is a trademark of Nelson Analytical, Inc.

ADAMS is a registered trademark of Mechanical Dynamics, Inc.

AddSys-3000 is a trademark of Precision Visuals, Inc.

AIM-Supervisor is a trademark of Biles & Associates.

Alis is a registered trademark of Applix, Inc.

ANSYS is a registered trademark of Swanson Analysis Systems, Inc.

ANVIL-5000 is a trademark of Manufacturing and Consulting Services, Inc.

Apple is a trademark of Apple Computer, Inc.

Apple LaserWriter is a trademark of Apple Computer, Inc.

Appletalk is a trademark of Apple Computer, Inc.

ARCAD is a registered trademark of International Graphics Engineering Systems.

AutoCAD is a registered trademark of AutoDESK, Inc.

AutoDRAW is a trademark of AI Systems.

Automatic Layout Editor is a trademark of Schlumberger Technologies, Inc.

B-MAP is a trademark of Zycor, Inc.

BLOX TEMPLATE is a registered trademark of Rubel Software.

BLOX is a trademark of Rubel Software.

BOXER is a trademark of PAFEC, Inc.

Bravo NC is a trademark of Schlumberger Technologies, Inc.

Bravo3 is a registered trademark of Schlumberger Technologies, Inc.

BravoDRAFT is a trademark of Schlumberger Technologies, Inc.

CAEMIS is a registered trademark of Impell Corporation.

CAL-PC is a trademark of Silvar-Lisco.

CAM-APT-SURF is a registered trademark of ICAM Technologies Corporation.

CAM-CAL2 is a registered trademark of ICAM Technologies Corporation.

CAM-FIVE-S is registered trademark of ICAM Technologies Corporation.

CAM-PLOT is a registered trademark of ICAM Technologies Corporation.

CAM-POST is a registered trademark of ICAM Technologies Corporation.

CANDE is a registered trademark of Technology Modeling Associates, Inc.

CEAL is a trademark of CLM/Systems, Inc.

CENTRUM is a trademark of Polygen Corporation.

CIS Medusa is a trademark of CIS Medusa, Inc.  
COSMOS is a trademark of Structural Research & Analysis Corporation.  
CPS-3 is a trademark of Radian Corporation.  
DAST is a trademark of Das Consulting, Inc.  
DATAMINE is a registered trademark of Mineral Industries Computing Ltd.  
dBase is a trademark of Ashton-Tate Corporation.  
DEPICT is a trademark of Technology Modeling Associates, Inc.  
Design Review is a trademark of Schlumberger Technologies, Inc.  
DI-3000 is a registered trademark of Precision Visuals, Inc.  
DI-3000XPM is a trademark of Precision Visuals, Inc.  
DIGSIM is a registered trademark of Digsim Systems.  
Dimension III is a trademark of GE Calma.  
DIS is a trademark of ADLPIPE, Inc.  
DISCOVER is a trademark of BIOSYM Technologies, Inc.  
DISSPLA is a registered trademark of Computer Associates International Inc.  
DI-TEXTPRO is a trademark of Precision Visuals, Inc.  
DRACULA is a trademark of Cadence Design Systems, Inc.  
DUCT is a trademark of Deltacam Systems Ltd.  
DV-Draw is a trademark of V.I. Corporation.  
EDGE is a trademark of Cadence Design Systems, Inc.  
Editor is a trademark of Schlumberger Technologies, Inc.  
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## Glossary

### **accelerators**

Shortcuts in DECwindows that let you interact with applications more quickly.

### **ALGOL**

An acronym for algorithmic language. ALGOL is one of the oldest programming languages.

### **aliasing**

The creation of an imperfect screen image characterized by jagged lines, like "stair steps." Aliasing is also known as the "jaggies" and "crawlies." *Contrast with antialiasing.*

### **ANSI**

American National Standards Institute. An organization that compiles and publishes industry standards.

### **antialiasing**

Hardware and software techniques that alleviate the effects of aliasing by smoothing jagged lines and edges using varying pixel sizes or intensities.

### **ARPANET**

Advanced Research Projects Agency Network. A network of computers located primarily at universities in the United States, but also overseas.

### **artifact**

An undesirable effect in a graphic object. *Aliasing* is a form of artifact.

### **ASCII**

American Standard Code for Information Interchange. A set of 8-bit binary numbers representing the alphabet, punctuation, numerals, and other special symbols used in text representation and communications protocols.

**asynchronous**

A method of data transmission in which an event is scheduled as the result of a signal asking for the event or as a result of the completion of another event. *Contrast with synchronous.*

**backbone network**

The network whose primary function is to forward network datagrams between other networks in an extended LAN. *See also Local Area Network; datagram.*

**backplane**

The area of a computer (or computer device) where logic and control elements are connected.

**backplane interconnect**

*See BI.*

**barrel connector**

A female connector for joining two sections of ThinWire cable. *See also ThinWire.*

**baseband network**

A type of network that carries a single channel of communications signals on a single cable. *Contrast with broadband network.*

**batch processing**

A method of scheduling and executing programs such that the programs run without programmer intervention.

**benchmark**

A set of standards to measure performance.

**BI**

The abbreviation for backplane interconnect. The BI is an internal processor bus used to communicate with the central processor and main memory.



**bit**

A binary digit; the smallest unit of data in a binary notation system, designated as 0 or 1.

**bit-blt**

Bit-block transfer. The transfer of a bit string or block of bits from one screen or memory location to another. Also called a raster-op.

**bitmap**

See **frame buffer**.

**bitplane**

See **frame buffer**.

**block mode**

Access mode that allows for direct access to blocks in a file without regard for file organization or record format.

**boot**

To bring a device or system to a defined state at which it can operate on its own.

**boot member**

The management center for a VAXcluster System; also, its major resource provider. See also **VAXcluster System**.

**Bourne shell**

See **shell**.

**bridge**

A device that connects two LANs to make one extended LAN. A bridge selectively passes messages from one LAN to another. See also **Local Area Network**.

**broadband network**

A type of network that uses multiple carrier frequencies to transmit many signals on a single cable. Contrast with **baseband network**.

**buffer**

A temporary data storage space.

**bus**

A cable that consists of many transmission lines or wires. It interconnects computer system components to provide communications paths for addresses, data, and control information.

**Cartesian coordinates**

A coordinate system that defines two or three independent axes (arbitrarily called the x and y or x, y, and z axes) that locate a point on a plane, measured from a starting point called the origin. World coordinates refer to the user-defined coordinates of an image before index values are added that translate the image to device coordinates. Device coordinates describe a physical position on the screen.

**CASE**

An acronym for computer-aided software engineering.

**cathode ray tube (CRT)**

A vacuum tube that generates and guides electrons onto a fluorescent screen to produce characters or graphics. *See also graphics CRT display.*

**CCITT**

Comité Consultatif International de Télégraphie et Téléphonie. Consultative Committee for International Telephone and Telegraph. The technical committee of the International Telecommunications Union (ITU) that is responsible for developing recommendations regarding telecommunications, including data communications.

**CDROM**

Compact disk read-only memory. CDROM is a new media for delivery of software products. Software on a compact disk requires a reader just as music on a compact disk requires a player.

**cell**

A rectangular set of pixels typically ranging from 6 x 8 to 10 x 14 pixels in size. Each cell is encoded in the frame buffer by some number of bytes that is less than would be required if each pixel were separately encoded.

**central processing unit**

The part of the computer system that controls the interpretation and execution of instructions.

**channel**

The physical data path joining two or more stations. *See also station.*

**child**

A sublevel in a hierarchical system. *See also root.*

**client**

A system on a network that uses the services provided by a server on the same network. *See also server.*

**clipping**

A masking process, performed by hardware or software, that prevents an image from appearing outside a predefined area, such as the boundaries of a window or a display area.

**cluster**

*See VAXcluster System.*

**CMOS**

The acronym for advanced complementary metal-oxide semiconductor technology, which is used in the following: VAXstation 3100, VAXstation 3200, the VAXstation 3500, and the VAXstation 3520/3540.

**color map**

A table of color values (usually defined in intensities of red, blue, and green) that translates a pixel value into a color. Bitmap values serve as indexes into the color map. *See also framebuffer.*



**compound document**

A compound document includes both text and graphics.

**Compound Document Architecture (CDA)**

An open and extensible foundation for the creation and exchange of multiple data types—text, graphics, spreadsheets, charts, tables, and images.

**Computer Interconnect (CI)**

A high-speed bus that interconnects VAXcluster System nodes and serves as the primary means of communication between them. *See also* **VAXcluster System; NI.**

**context**

The environment of an activity, including the state of the hardware and software during processing.

**controller**

A device that regulates the operation of one or more peripheral devices.

**coordinates**

*See* **Cartesian coordinates.**

**coprocessor**

Specialized versions of CPU chips that perform special functions required by applications. *See also* **display processor.**

**cursor**

A character or symbol that indicates the data entry position on the display screen.

**crawlies**

*See* **aliasing.**

**cross-sectioning**

A rendering operation that uses a sectioning plane to create a cross-section of an object.

**C shell**

*See shell.*

**DARPA**

Defense Advanced Research Projects Agency. A funding agency for the computer network experiments performed over the ARPANET. *See also* ARPANET.

**datagram**

A message passed between network nodes.

**DCL**

Digital Command Language. The standard command interface to Digital's major operating systems.

**DDIF**

Digital Document Interchange Format. A standard format for the storage and interchange of compound documents.

**DECconnect**

Digital's simple, cost-effective cabling system for extending Ethernet and terminal interconnections into offices and work areas.

**DECnet**

Networking software designed and developed by Digital. DECnet is an implementation of the Digital Network Architecture.

**DECnet System Services (DSS)**

A product that allows workstation users to share data, printers, and system management.

**DECterm**

In DECwindows, DECterm creates a window that emulates a VT320 series window.

**DECwindows**

Digital's implementation of the de facto standard X Window System for use with VMS, ULTRIX, and MS-DOS operating systems. *See also* **X Window System**.

**depth-cueing**

An operation that gives depth to a display of a 3D object by varying line intensity in the positive Z-axis.

**DEMPR**

Digital ThinWire Ethernet Multiport Repeater. A multiport repeater that provides eight ThinWire Ethernet drops from a single standard Ethernet connection. *See also* **repeater**.

**DEREP**

*See* **repeater**.

**DESTA**

Digital ThinWire Ethernet Station Adapter. A station adapter that acts as a ThinWire Ethernet transceiver. A DESTA allows you to connect to a station with a transceiver cable to ThinWire Ethernet.

**device coordinates**

*See* **Cartesian coordinate**.

**device driver**

The software that converts device-independent operating commands into device-specific hardware operations.

**Digital Network Architecture (DNA)**

The set of specifications for Digital's proprietary network protocol, DECnet. DNA defines protocols for seven layers of functions and conforms to the internationally accepted ISO model. *See also* **DECnet**; **OSI**; **ISO**.

**Direct Memory Access (DMA)**

The ability to transfer data directly to or from memory without passing it through the central processor.



**direct-view storage tube**

*See* **graphics CRT display**.

**display buffer**

An area of computer memory reserved for graphics instructions and data.

**display coordinates**

*See* **Cartesian coordinates**.

**display cycle**

The time it takes to fill the display screen with a picture, blank the screen, and reposition the electron beam to begin the next display cycle.

**display list**

A sequence of graphics commands that, when executed, cause an image to display.

**display processor**

A special-purpose CPU, with its own set of commands, data formats, and an instruction counter, that executes a sequence of display instructions to create a drawing on the display device.

**distributed processing**

The technology that enables computing power and storage facilities to be distributed to user work areas such as offices, labs, or desks on factory floors. Distributed processing grew out of the realization that users wasted time by having to wait for answers to their questions from isolated and remotely located mainframe computers.

**distributed system**

A system of computing resources, physically carried over a Local Area Network, extended Local Area Network, or Wide Area Network, but managed as a single entity. A distributed system presents to its users the appearance of a single integrated computing resource.

**DMA**

*See* **Direct Memory Access.**

**DNA**

*See* **Digital Network Architecture.**

**downline loading**

Transmission of a system image from one computer to another on which the image is then loaded and executed.

**drawing operation primitive (DOP)**

A basic display element, such as a point, vector, or character string, that can be executed by commands stored in the display list.

**escape sequence**

A sequence of characters beginning with the ESCAPE character (ASCII-Decimal 27). An escape signals a transition from one mode of operation to another.

**Ethernet**

A type of Local Area Network that uses a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) scheme to arbitrate the use of a 10 megabits-per-second baseband coaxial cable. *See also* **Local Area Network.**

**extended LAN**

Multiple Local Area Networks interconnected by bridges. *See also* **Local Area Network; bridge.**

**filter**

A program that reads input from standard (default) input and writes to standard output.

**flicker**

A fluctuation of the displayed image usually caused by an insufficient refresh rate. Flicker can be reduced by using faster hardware and software. *See also* **refresh rate.**

**floating-point processor (FPP)**

A processor that works with the central processor, added to a system to increase the speed of mathematical operations, specifically floating-point operations.

**floating-point representation system**

A numeration system in which a real number is represented by a pair of distinct numerals, the real number being the product of the first numeral (a fixed number) and a value obtained by raising the implicit floating-point base to a power denoted by the exponent, indicated by the second numeral. This system allows 32-bit representation of a wider range of values than does a fixed-point notation.

**font**

A specific representation of text characters, that is, typeface, typesize, and character rendition.

**frame buffer**

Memory used to store an array of graphic image data. Each element of the array corresponds to one or more pixels in a video display or one or more dots on a laser printer. Also called a bitmap or bitplane. *See also* **color map; display pipeline; pixel**.

**gateway**

A module or set of modules that transforms the conventions of one network into the conventions of another. For example, a DEC SNA gateway transforms a DEC DNA network to an IBM SNA network.

**Graphical Kernel System (GKS)**

An ANSI-approved, high-level, device-independent graphics interface that supplies a set of drawing functions.

**graphics**

The use of lines, figures, shapes, and shaded areas to display information.



**graphics coprocessor**

**See display processor.**

**graphics CRT display**

One of three basic forms of graphics CRT displays: raster-scan, directed-beam refresh, or direct-view storage tubes.

The raster-scan form is used in commercial television. It operates by varying the intensity of a beam that periodically scans left to right, top to bottom, along the fixed number of a screen's scan lines.

In directed-beam refresh display, the beam moves from point to point on the screen to produce the desired image, rather than scanning periodically. The image is maintained by being redrawn at a periodic refresh rate.

Direct-view storage tube devices use the same method as directed-beam refresh displays to draw an image. Since the image is stored in the phosphor of the screen, however, periodic refresh is not necessary.

Full color is available only on raster-scan display devices.

**graphics tablet**

**See pointer devices.**

**gray-scale**

The level of brightness that describes the illumination of a monochrome CRT screen.

**heterogeneous network**

A network that accommodates different types of computer equipment and operating systems.

**host**

1) The primary or controlling computer in a multiple computer network. 2) A network node that performs services for other nodes in the network.

**HP-GL**

Hewlett-Packard Graphics Language. The graphics language instructions interpreted by various Hewlett-Packard plotters and other graphics devices.

**icon**

A graphic or pictorial representation of a function displayed on the video screen.

**IEEE**

Institute of Electrical and Electronics Engineers. A United States-based professional society active in some areas of computer standardization.

**image**

1) The executable form of a program. 2) Duplicate data copied from one medium to another. 3) The output form of online graphics data.

**image applications**

ULTRIX programs that describe and manipulate pictures (graphical data) for hard-copy output.

**interlace**

The display of every other horizontal line of pixels to reduce flicker on a video display screen.

**International Organization for Standardization (ISO)**

An international standards-defining body based in Geneva, Switzerland.

**interprocess communication**

The act of passing information between two or more system processes. *See also* **process**.

**joy stick**

*See* **pointer devices**.

**kernel**

The minimum core of the operating system.

**load balancing**

The method of distributing users and resources among VAX processors for maximum productivity.

**Local Area Network (LAN)**

A data communications system that operates over a limited physical distance (without bridges), using high-speed communications channels optimized for connecting information processing equipment.

**Local Area VAXcluster System**

Software associated with VMS that allows up to 41 MicroVAX systems and VAXstations (including one host VAX or MicroVAX system, called the boot member, for each group of up to 14 systems), all connected by Ethernet (also known as Network Interconnect or NI) to share computation and storage facilities. VAXcluster System software supports downline loading and system management functions from the boot member. Diskless workstations must be part of a VAXcluster System.

**LSI technology**

Large Scale Integration. The technology for integrating a large number of circuits on a single chip or semiconductor.

**memory management**

The operating system functions that affect the hardware's mapping and protection and the operating system's image activator and pager.

**menu**

A displayed list of options or functions from which a user can select to activate programs and operations.

**metafile**

A pseudodisplay file that can be stored as a self-sufficient, low-level, but still device-independent, picture description.



**microcomputer**

A computer that uses a microprocessor as its CPU and includes a memory and input/output circuits. *See also microprocessor.*

**microprocessor**

The control and processing section of a small computer usually made up of LSI chips. *See also LSI technology; VLSI technology.*

**MILNET**

Military Network. A domain of the ARPANET for use by the military.

**monochrome**

A drawing using shades of a single color.

**mouse**

*See pointer devices.*

**MS-DOS**

A Disk Operating System used widely with personal computers and developed by MicroSoft Corporation.

**MS-Windows**

A software application developed by MicroSoft Corporation that manages data displayed on the CRT screen in rectangular areas known as windows. The user interacts with the software by selecting icons and menu items from the screen.

**multitask**

Declaring parts of a given application to execute concurrently with each other and with the main program.

**multiwindow**

Software supporting more than one window on a screen at the same time. *See window.*

**NCP**

Network Control Program. The control program that implements the second-level host-to-host protocol for a specific operating system. *See also network management.*

**Network Applications Support (NAS)**

Digital's architecture that integrates the desktop software environment.

**network**

A configuration of information processing equipment connected by communications lines to share information and resources.

**network coordinator**

The person who manages the network, assigns unique node names and addresses for each station on the network, and provides administrative assistance to network users.

**Network File System (NFS)**

A vendor-independent product developed by Sun Microsystems, Inc., and integrated with Digital's ULTRIX systems. It supports transparent access to shared files among heterogeneous workstations. NFS is supported by more than 30 major computer companies.

**network management**

Digital Network Architecture functions that enable operator control over and observation of network parameters and variables. Network management also provides downline loading, upline dumping, and testing functions. *See also Digital Network Architecture; downline loading; upline dumping.*

**NI**

Network Interconnect. *See Computer Interconnect; Ethernet; VAXcluster System.*

**node**

A network-addressable component having a unique address or identification.

**NSP**

Network Services Protocol. Network protocols for DECnet-VAX and DECnet-ULTRIX.

**object code**

Relocatable machine language code that results from assembling or compiling source code.

**occluded window**

A window that is partially or completely covered by another window on display.

**Open Software Foundation (OSF)**

A consortium of more than 70 organizations whose purpose is to promote standards in the computer industry.

**Open System Interconnection (OSI)**

ISO's proposed international standard for network architectures that defines a seven-layer model, specifying services and protocols for each type. *See also* **International Organization for Standardization**.

**operating system**

A collection of programs that control the operation of the computer and perform such tasks as input/output, scheduling, and memory management. *See also* **VMS; ULTRIX; UNIX; MS-DOS**.

**origin**

The zero reference point of a coordinate system typically in the upper left or lower left corner of the display screen. *See also* **Cartesian coordinates**.

**palette**

The set of all colors available for screen displays on color workstations.



**parallel processing**

An approach to improving the performance of computers by parceling out the computation to a set of CPUs that can function in parallel. This approach requires special hardware and software to effectively coordinate the processing.

**pattern fill**

A monochrome design, such as dots or stripes, contained within the outline(s) of an object in a graphics display.

**Personal Computing Systems Architecture (PCSA)**

Digital's networking solution for incorporating PCs into the larger VAX-based corporate network.

**PEX**

PHIGS Environment for X. An industry-standard interface for 3D applications on X11.

**PHIGS**

Programmer's Hierarchical Interactive Graphics Standard. A graphics programming architecture that uses hierarchically structured display files, allowing for rapid dynamic display and modification of 2D and 3D graphical data.

**physical coordinates**

The actual values used by graphics hardware to address a pixel. *See also pixel.*

**pipe**

A two-way communications channel between two processes. A series of filters can be separated by pipes so that the standard output of one command becomes the standard input of the next. *See also filter.*

**pixel**

Picture element. The smallest addressable component of a displayable image. Each pixel has an associated value and a bitmap address in a two-dimensional Cartesian coordinate system.

**plane**

An area of memory where each bit in the memory corresponds to one pixel on the screen. Systems commonly have from one to 32 planes, depending on the number of colors required.

**pointer devices**

Input devices, such as a mouse, joy stick, graphics tablet and puck, or thumbwheels, used to provide coordinate information to the system.

**polygon**

A closed figure defined by the coordinates of its vertices. The edges of a polygon are defined by the lines connecting its vertices.

**polygon fill**

The process of filling polygons on a raster display with color.

**polyline**

A connected sequence of line segments, in which each pair of segments has a common endpoint. A polyline in which the last segment has a common endpoint with the first is a polygon.

**polymarker**

A sequence of markers placed at various positions; for example, a line graph with markers at each vertex (endpoint) in the graph. In GKS, the markers can be positioned with the polymarker function.

**POSIX**

Portable Operating System Interface for Computer Environments. An IEEE standard for an operating system interface. Applications conforming to the POSIX specification will run on any other POSIX-conforming system, thus allowing application software to run on multiple operating systems. Digital will implement POSIX on VMS.

### **PostScript**

A page description language, developed by Adobe Systems, Inc., and supported by many vendors, including Digital, that provides a device-independent standard for representing the printed page. PostScript programs representing any kind of graphical data, including character fonts, are interpreted by PostScript interpreter hardware. The output generated is then printed by special laser printers or typesetters. Digital's PrintServer40 and LN03R printers support PostScript.

### **process**

The hardware and software context and address space in which an image executes. *See also context.*

### **protocol**

1) A basic procedure or set of rules that controls communications between computers. 2) A set of conventions between communicating processes regarding the format and contents of messages to be exchanged.

### **port**

The connector at the back of the computer to which a terminal, printer, or other communications device is connected.

### **puck**

*See pointer devices.*

### **Q-bus**

The common communications path for the data, address, and control information that is transferred between the CPU, memory, and device interfaces.

### **QDSS**

Q-bus Device Subsystem. A 4- or 8-plane video subsystem component of a VAXstation II/GPX workstation. Also called VCB02. *See also plane; QVSS.*



**QIL**

A library of low-level graphics subroutines used by ULTRIX workstation client programs written in the C language. These subroutines allow the program to access the color video subsystem hardware functions.

**QIO**

Queue Input/Output. VAX/VMS system services that prepare I/O requests for processing by the device driver and perform device-independent preprocessing of the requests.

**QVSS**

Q-bus Video Subsystem. A single-bitplane video controller used with the VR260 monochrome display to provide a 1024 x 2048 single-plane array of bitmapped memory. Also called VCB01. *See also plane.*

**raster**

A technique for producing an image on a CRT screen. Raster images are generated with an intensity-controlled, line-by-line sweep of the electron beam across the screen. Television sets use raster displays. *See also graphics CRT display.*

**raster-op**

*See bit-blt.*

**raster-scan**

*See graphics CRT display.*

**real time**

In graphics systems, real time refers to interactive operations in which the operator can interact with the displayed image with no apparent delay.

**refresh rate**

The speed with which the raster is redrawn. Normally, the raster is redrawn from 60 to 72 times per second.

### **ReGIS**

Remote Graphics Instruction Set. A set of commands and subroutines that draw pictures and plot data, used by Digital's VT240 graphics terminals.

### **Remote System Manager (RSM)**

RSM offers central system management for distributed VAX systems.

### **rendering**

Refers to graphics operations such as hidden-line removal, hidden-surface removal, sectioning, and shading.

### **repeater**

The interconnecting link between two Ethernet cable segments. The repeater provides a means of extending Ethernet networks beyond the limits imposed by a single segment.

### **resolution**

The density and overall quality of a video display determined by the size and organization of its pixels. *See also* pixel.

### **resource**

An identifiable, shareable hardware or software entity that is required to perform a service and that can be named and accessed on the network. Examples are printers, disks, processors, fonts, forms, and layouts.

### **RISC**

Reduced Instruction Set Computer. RISC designers reduce the number of instructions and let compilers synthesize more complex operations. Since the instruction set is simpler, the hardware logic can be less complex. Thus, instruction execution time is reduced and processing speed increases dramatically.

**root**

The top level in a hierarchical system. For example, root window.

**rotation**

Turning all or part of a display image around an axis.

**router**

A station that uses upper-level protocols to control network communications among other stations.

**satellite member**

A node that is dependent on a host for functions, such as downline loading, upline dumping, testing, and restarting.

**satellite equipment room**

A room or wiring closet used as the central wiring hub for an office network configured using DECconnect.

**scaling**

Enlarging or reducing all or part of a display image by multiplying its coordinates by a constant value.

**SCSI**

Small Computer Systems Interconnect. An interface for connecting disks and other peripheral devices to computer systems. SCSI is defined by an American National Standards Institute (ANSI) standard and is widely used throughout the computer industry.

**screen refresh rate**

The rate at which information on the monitor screen is re-displayed.

**script**

A file of shell commands. *See also* shell.



**segment**

1) A length of coaxial cable made up of one or more cable sections connected with connectors. LANs have restrictions as to length of cable and number of stations. LAN segments can be connected using repeaters, and bridges can be used to make extended LANs. *See also* **Local Area Network; repeater; bridge; station.** 2) In GKS, a part of an object description or display list. Segments, which are used as output primitives, allow a program to change part of a display quickly without having to refresh the entire screen. *See also* **Graphical Kernel System.**

**serial lines**

Communications wires on which each bit of information is sent sequentially on a single channel.

**server**

A node or process that performs a service or set of related services to network clients. *See* **client.**

**shading**

The process of drawing the surface of a polygonally defined object. Examples of shading are flat, smooth, and wash.

**shell**

An ULTRIX operating system program that handles communication between the system and its users. The shell is a command language interpreter and can also serve as a programming language. The two shells in common use are the Bourne shell and the C shell.

**sixel**

Six pixels. Some devices (such as the LA50 printer) and supporting software print or manipulate screen data in sets of six pixels.

**solid**

In computer graphics, an object comprising many polygons that encloses a volume of space. Every edge of every polygon must coincide with an edge of an adjacent polygon if the object is to be solid.

**source file**

Text usually in the form of an ASCII format file that represents the human readable portion of a program.

**standard Ethernet**

An IEEE standard 802.3-compliant Ethernet network made of standard Ethernet cable, as opposed to ThinWire Ethernet cable. Also called thickwire.

**station**

A termination on a data link. A station is a combination of the physical link (communications hardware) and the Data Link protocol implementation at a node.

**stippling**

In computer graphics, mixing dots (pixels) of different colors to create another color or to give the effect of color blending.

**streaming**

Pertaining to magnetic tape on which data is stored and read sequentially.

**stylus**

A hand-held pointing device corresponding to a pencil, used with a tablet to input data. *See also* **pointer devices**.

**synchronous**

A method of data transmission. Each event operates in relation to a timing signal. *Contrast with* **asynchronous**.

**System V**

A release of the UNIX operating system generated by AT&T in January 1983.

### **TCP/IP**

Transmission Control Protocol/Internet Protocol. A networking protocol developed and standardized by DARPA for ARPANET and MILNET.

### **terminal emulator**

A workstation software component that allows a workstation user to operate in a window as if it were a certain type of terminal, such as a VT220 or a Tektronix 4014. In terminal emulation, a user can log in to a remote computer if the appropriate communications software is installed.

### **thickwire**

See **standard Ethernet**.

### **ThinWire**

A Digital trademark used to describe its IEEE-compliant Ethernet products used for local distribution of data communications.

### **thumbwheel**

See **pointer devices**.

### **tile**

A linear pattern whose origin coincides with the screen origin and whose edges are parallel to the x- and y-axis. Conceptually, a tile pattern covers the bitmap address space.

### **timesharing**

A method of allocating resources to many users so that the computer in effect processes a number of programs concurrently.

### **topology**

The physical arrangement and relationship of interconnected nodes and lines in a network.

### **transformation**

In computer graphics, an operation, such as scaling or rotation, that modifies an image.



**translation buffer**

An internal processor cache (storage buffer) that contains translations for recently used virtual addresses.

**UIS**

User Interface Services. A library of shared routines supported by the VMS Workstation Software for manipulating graphics, using world coordinates. *See also* **world coordinates**.

**UISDC**

User Interface Services Device Coordinates. A library of shared routines supported by the VMS Workstation Software for manipulating graphics, using device coordinates. *See also* **device coordinates; pixel**.

**ULTRIX**

Digital's implementation of the UNIX operating system software.

**ULTRIX Worksystems Software**

The operating system kernel, window server, and graphics software for an ULTRIX VAXstation.

**UNIX**

A general-purpose, multiuser, interactive operating system originally developed by AT&T Bell Laboratories on Digital's PDP-7 and PDP-11 systems.

**upline dumping**

The process of transmitting a copy of a computer's memory over a logical link and storing the copy in a file on another node.

**VAX**

Virtual Address Extension. A family of high-performance, multiprocessing computer systems developed by Digital Equipment Corporation based on a 32-bit architecture.

### **VAX Bus Interconnect**

Also called the VAXBI and BI, the VAX bus interconnect is a synchronous, time-multiplexed, 32-bit interconnect.

### **VAXcluster System**

A multipurpose system that provides the computer power, data resources, and storage capabilities of mainframe systems by connecting VAX processors and storage controllers. VAXcluster Systems are managed as a single system that runs the VMS operating system. There are three implementations: CI, Local Area, and mixed-interconnect.

1. CI uses the Computer Interconnect high-speed bus to connect large VAX processors (not workstations).
2. Local Area uses Ethernet to connect smaller VAX processors, including workstations.
3. Mixed-interconnect uses both the CI and Ethernet to connect large and small VAX processors.

### **VAXserver**

A specially configured MicroVAX CPU that provides additional compute power and mass storage on a network.

### **VCB01**

See **QVSS**.

### **vector**

1) A line segment (usually visible) on a graphics display. Two points define a vector. 2) A quality or line that has both magnitude and direction.

### **video device controller**

The controller used with the monochrome or color display that stores graphics information and generates graphics images on the video screen. The VAXstation II and VAXstation II/GPX systems use the QDSS and QVSS video controllers. The VAXstation 2000 uses a special version of those controllers in the MicroVAX 2000 system box. See **QDSS**; **QVSS**.

**video display terminal**

A terminal that displays information on the screen of a cathode ray tube (CRT).

**viewing area**

A 3D region of world coordinate space in which objects can be viewed. *See also* **Cartesian coordinates**.

**viewport**

In graphics programming, an area of the screen on which an image is displayed. *See also* **window**.

**virtual memory**

The address space that the program can access. This address space may not be all physically available at the same time.

**VLSI technology**

Very Large Scale Integration. A technology that fits a large number of integrated circuit chips on a printed circuit board. Since fewer boards are needed, the system can be engineered in a smaller package.

**VMS**

Virtual Memory System. The operating system used by VAX family members. *See also* **VAX**.

**VMS Workstation Software (VWS)**

Before DECwindows, this was software layered on VMS that manages windows on the screen and provides programmer and user interfaces to window functions.

**Wide Area Network (WAN)**

1) Multiple LANs and extended LANs interconnected by routers. 2) Two or more computer networks connected by routers and/or gateways.



**widget**

A type of window that implements a user interface feature (such as scroll bars, dialog boxes, and editable text fields). Applications can invoke widgets in their own windows, eliminating the need to write the user interface code and ensuring that the mechanisms function in the same fashion across applications.

**window**

1) A rectangular area on the video display screen in which graphics, text, or menus are displayed. Each window can be used to execute a separate process. In graphics programming, this area is called a viewport. 2) In graphics programming, a rectangular region in world coordinate space that contains the information the programmer wants displayed at a certain time.

**Window Manager**

In DECwindows, the Window Manager moves, stacks, and changes the size of windows.

**wire-frame**

Line drawing in which many lines are used to show the contours of a three-dimensional object.

**workstation**

A single-user system that offers high-performance, high-resolution graphics and can function in a network environment.

**world coordinates**

The 3D space in which objects are modeled in computer graphics. *See also* **Cartesian coordinates**.

**Xlib**

A function library used in the X Window System.

**Xserver**

The process (under the X Window System) that accesses the graphics hardware on behalf of applications.

**X Toolkit**

A high-level programming interface to the Xserver that simplifies the programming design of the user interface.

**X Window System**

An application programming interface for window, graphics, and user interface services developed at the Massachusetts Institute of Technology (MIT) with support from Digital.

**X.400**

A set of standards approved by CCITT that specifies how networks may exchange electronic messages among private mail systems and/or public communications carriers.

**X.25**

A CCITT-recommended standard for communication by devices across public carrier networks.

**Yellow Pages**

An NFS administrative service that distributes and maintains data needed in defining the network, its users, and services. *See also* **Network File System**.

**ZMOS**

Two-layer metal oxide semiconductor used in MicroVAX systems.

**zoom**

The visual effect achieved by repeated image scaling and translation.

1871

The first of the year was a very dry one, and the crops were much injured by the drought.

1872

The second of the year was a very wet one, and the crops were much injured by the rain.

1873

The third of the year was a very dry one, and the crops were much injured by the drought.

1874

The fourth of the year was a very wet one, and the crops were much injured by the rain.

1875

The fifth of the year was a very dry one, and the crops were much injured by the drought.

1876

The sixth of the year was a very wet one, and the crops were much injured by the rain.

1877

The seventh of the year was a very dry one, and the crops were much injured by the drought.

1878

The eighth of the year was a very wet one, and the crops were much injured by the rain.

1879

The ninth of the year was a very dry one, and the crops were much injured by the drought.

1880

The tenth of the year was a very wet one, and the crops were much injured by the rain.

1881

The eleventh of the year was a very dry one, and the crops were much injured by the drought.



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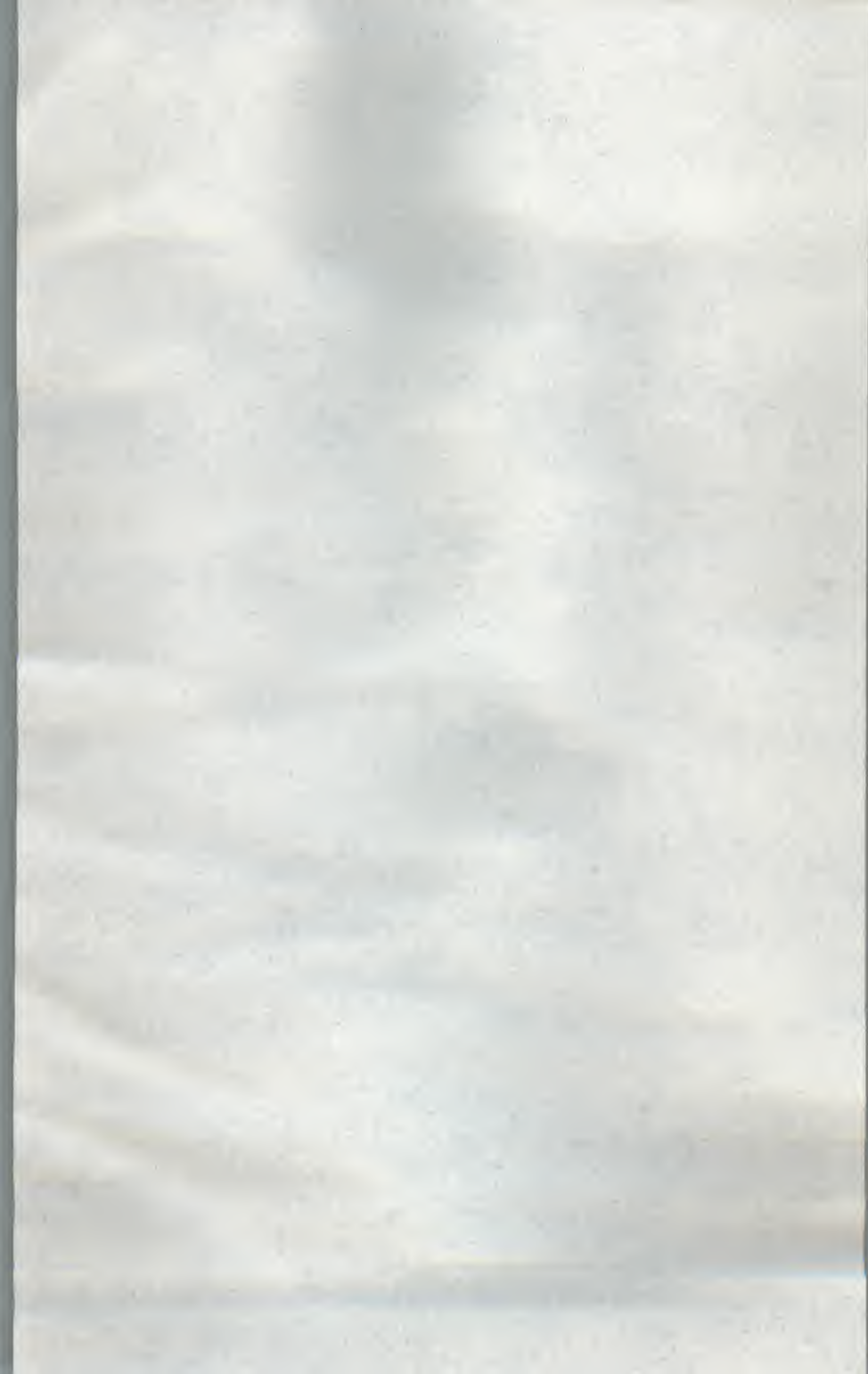
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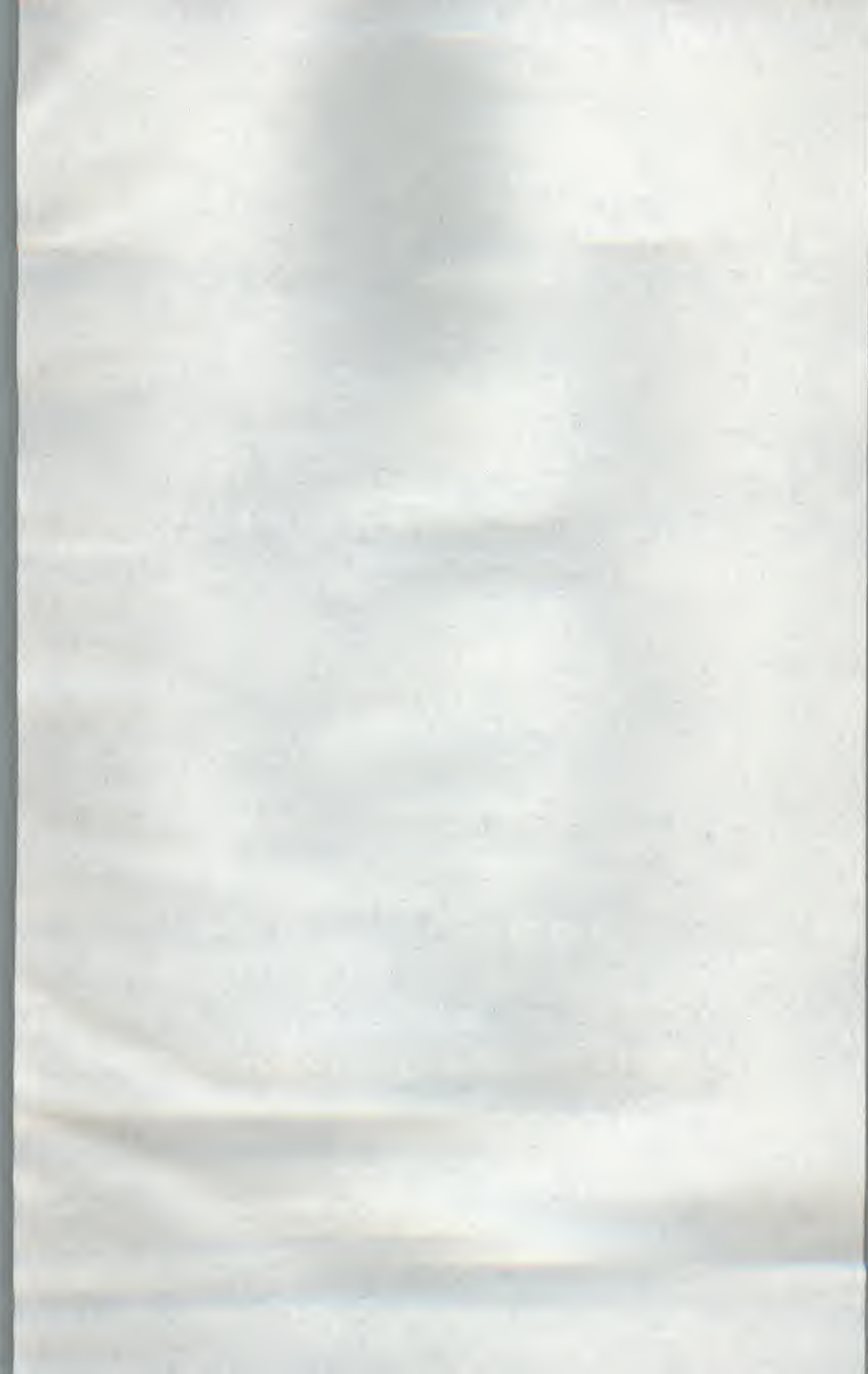
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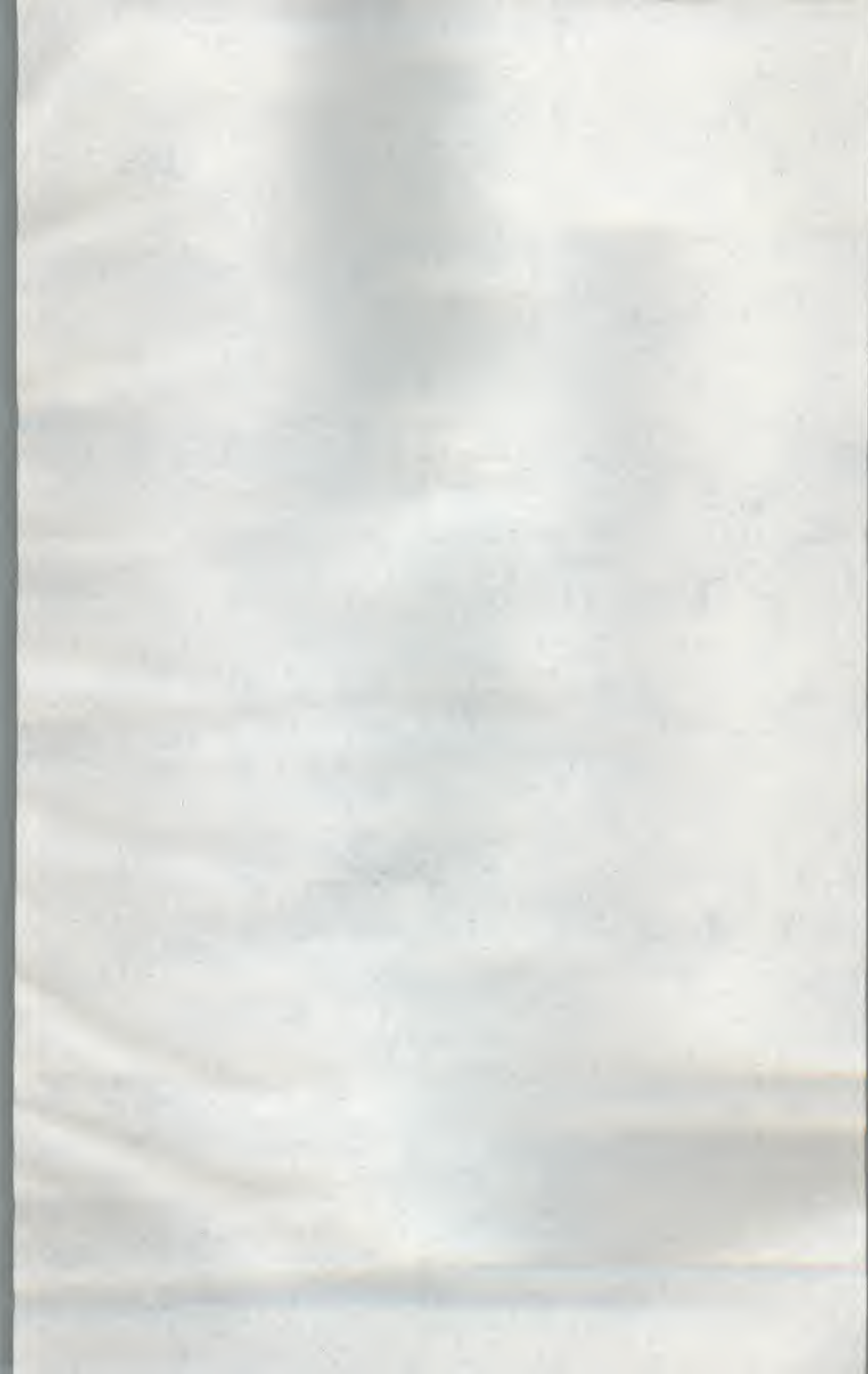




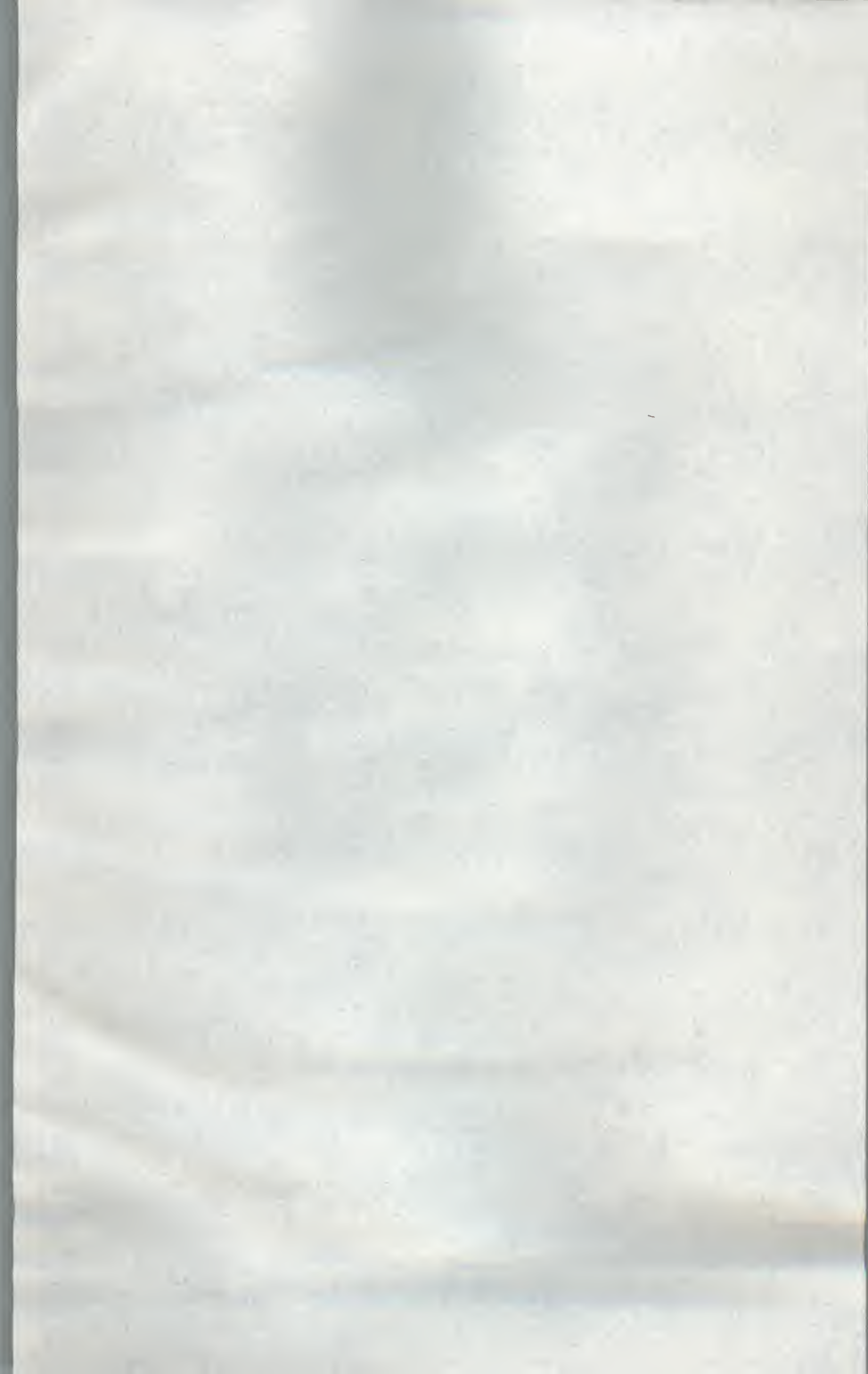
















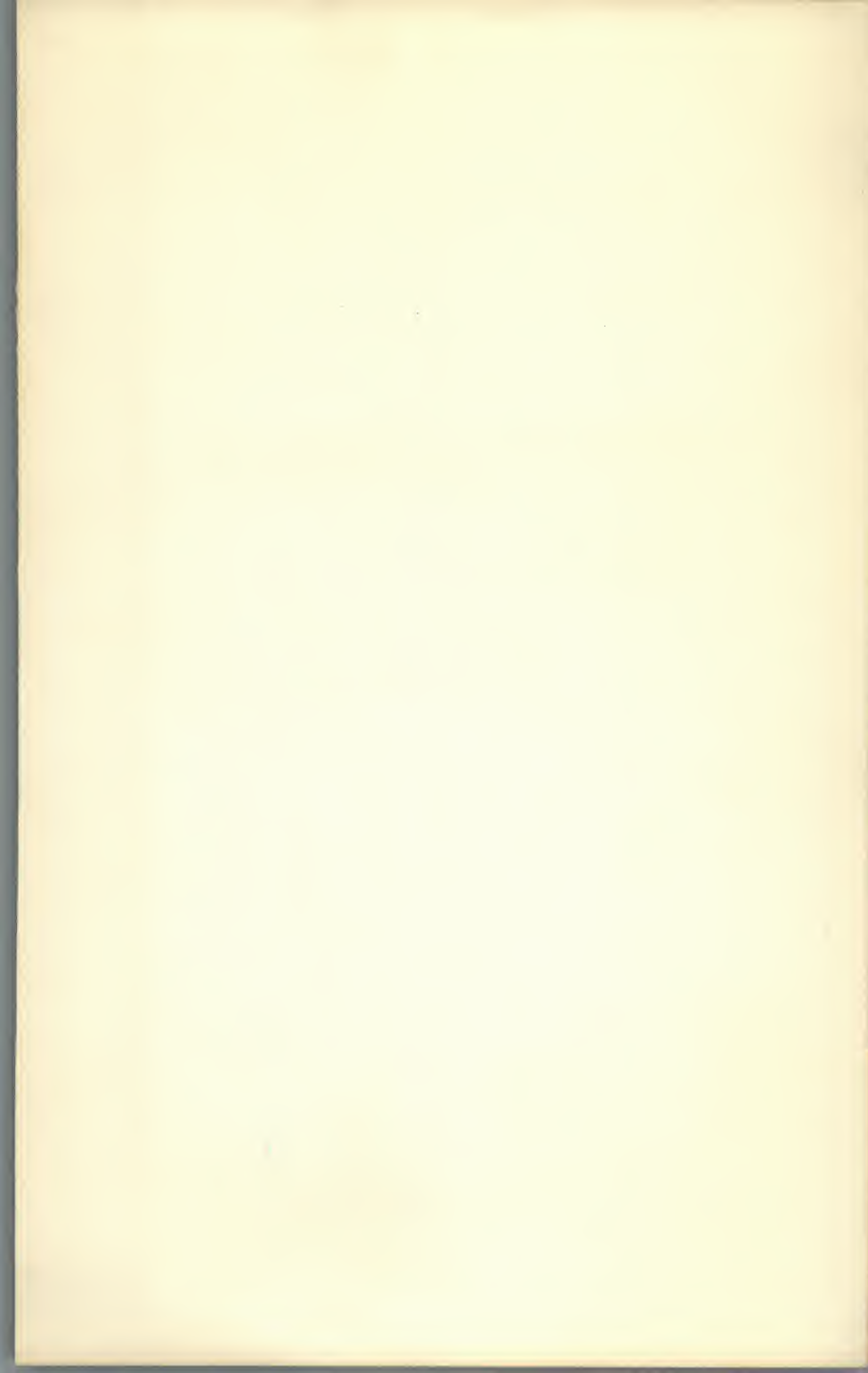




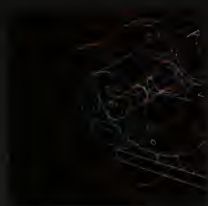












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